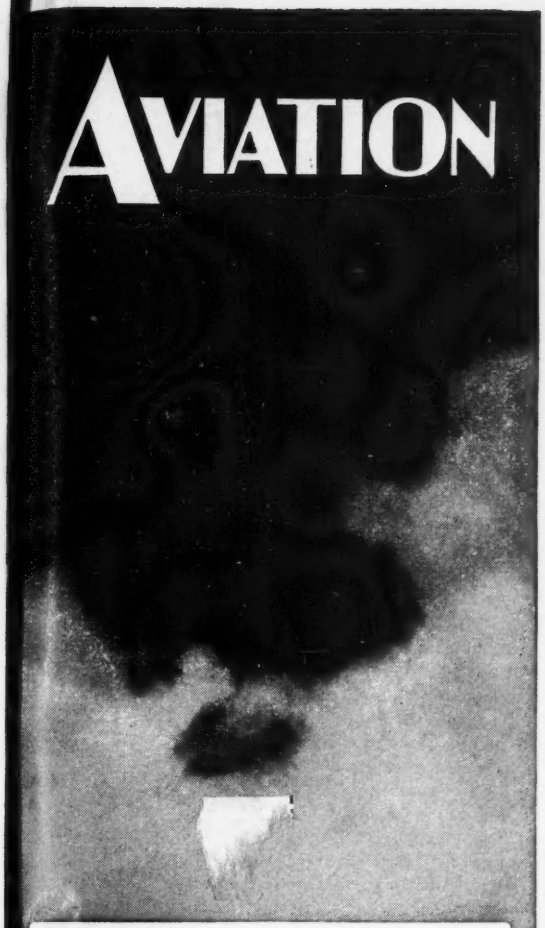

January, 1944

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Jay P. AuWerter ..... *Captain, Air Forces*
Charles F. McReynolds ..... *Captain, Air Forces*
Randolph Hawthorne ..... *Lieut., Air Forces*
Kenneth D. Reynolds ..... *Lieut., Infantry*
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Don Fink ..... *Special Assignment*
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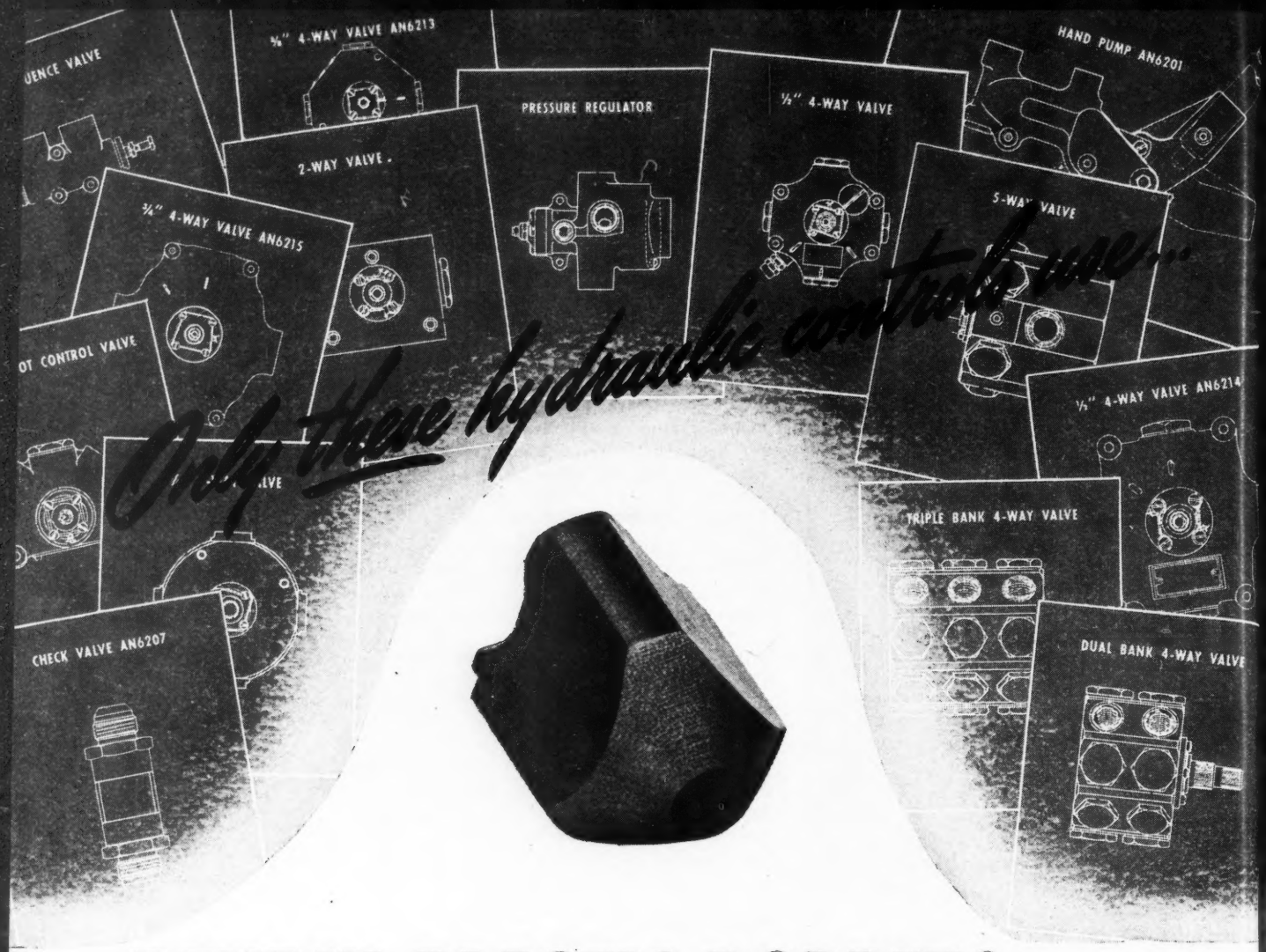

BENDIX PLASTIC POPPETS

Five years ago Bendix Aviation, Ltd., engineers conceived the possibility of using plastic poppets* in hydraulic equipment. They were lighter . . . were self-seating in the body without using inserted seats . . . and they improved with use.

Two years of testing followed. Formula and design were perfected, life tests of thousands of hours were completed, and the new development withstood every temperature, immersion, fracture, and cycling test.

Today Bendix Plastic Poppets have amassed an unparalleled service record. Installed in fourteen different Bendix hydraulic controls, they are in constant use on thousands of airplanes around the world – and confirmed service reports conclusively have proven that Bendix Plastic Poppets stand up under impact that caused metal poppets to fail.

Patents Pending

There are other uses being made of plastic material which have no connection with the Bendix design or application. Yet many seem to assume that the leadership we have achieved in plastic poppets must be responsible for the operation of all plastics, good or bad. This is the handicap imposed on leadership.

In fairness, we urge you to remember that the proven Bendix design and application of plastic poppets *is only available in Bendix hydraulic controls.* Bendix Aviation, Ltd., North Hollywood, California. Sales Engineering Offices in St. Louis, Dayton and New York.

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NORTH HOLLYWOOD, CALIF.
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DESIGNERS AND MANUFACTURERS OF RADIO AND HYDRAULIC EQUIPMENT — OUR PART OF THE INVISIBLE CREW

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Briefing for January

Willy Ley (left), born and educated in Germany, became associated with Prof. Hermann Oberth in rocket work around the middle 20's. Author and editor of works on rocket theory, he became vice-president of the German Rocket Society in 1928 and devoted most of his time to administrating research on liquid fuel rockets. It all ended in 1932 with Hitler. Now in this country, his current work is of the editorial type and he is not doing much "for the duration" in the rocket line. However, his fund of knowledge is considerable and valuable to us. The first of a series of articles on rocket and jet propulsion developments begins in this issue on Page 147. **Carl E. Swanson's** (center) work on supercharged ignition harnesses is a major contribution to operational aviation. As electrical engineer for Northwest Airlines, his inventions resulted in a record of 5,000,000 engine miles without ignition trouble. For a detailed description and appraisal of his work see Page 209. **Paul J. Frizzell** (right) is assistant general manager of Fairchild Engine & Airplane Corp. at Hagerstown. He contends that utter realism is a prerequisite to sensible postwar aviation appraisals, and he cites facts and figures to show why overselling the capabilities of the aviation industry in the early postwar period represents a dangerous threat to industrial security. Turn to Page 118.

One of the most important problems facing the aircraft industry today is reconversion from military to peacetime production. Abrupt termination of contracts would be catastrophic, yet there is a serious question as to what alternative could be offered to establish a sound program to diminish activity back to normal. Donald W. Douglas offers a number of specific suggestions in his article on Page 114.

First publication of the results of a representative survey of the postwar personal airplane market is offered this month by AVIATION. Conducted for Parks Air College, which is planning a far-reaching and comprehensive dealership, the survey is qualitative and as well as quantitative, revealing which types of aircraft the public prefers and why. Page 116.

Costly economics of airport design and construction are dictated by limitations of flying equipment with respect to landing and takeoff. Airports could be simplified, thereby increasing their number and utility, if landing gears were designed to permit safe crosswind landings. Page 120.

The aircraft industry's existence has been threatened by thoughtlessly ominous contract termination prospects. Bernard Baruch now heads a program promising an orderly reconversion—provided the manufacturers do their part in the plan. Page 122.

AVIATION'S Design Analysis series continues this month with No. 4—the Douglas A-20 *Havoc* attack-bomber. Replete with sketches and photographs by the dozens, as well as tables of dimensions and weights, this 22-page feature is another invaluable reference work for the engineer's library. Page 125.

Pouring of magnesium engine castings in a converted iron foundry is one of the unsung classic production achievements adding up to the term "Victory." For description of step by step procedure at Chevrolet General Motors see Page 150.

A tremendous amount of research preceded the spotwelding operations in fabricating the Lockheed *Constellation*. Our full report on these operations will serve as an invaluable guide to fabrication engineers. Page 161.

Greater pressures in modern hydraulic systems call for highly developed control mechanisms. First of a comprehensive series of articles on the subject of hydraulics control begins on Page 169.

Key to the miracle of American air power is the NACA. The part its development has played in this war and the need for its expansion is supported in an article on Page 175.

Use of Masonite horizontal patterns, traveling jack-knife drills, and combination drill-countersinking tools cut aircraft panel fabrication time per jig from 300 man-hours to 77.5 at North American Aviation. For details see Page 176.

A specialized method whereby airline pilots may do the "needle in a haystack" job of finding a small island in a large ocean is described on Page 231.

Down the Years in AVIATION'S Log

25 Yr. Ago (1919)—New York-Chicago airmail route discontinued as unsuccessful. . . . Dept. of Military Aeronautics asks bids on surplus engines and planes. . . . Curtiss announces New York-Atlantic City flying boat service. . . . All-metal wings pass Army test at McCook Field. . . . Norway-Scotland airline projected. . . . New York police study aeronautics for special flying squad.

15 Yr. Ago (1929)—Glenn Martin starts factory at Baltimore. . . . Stearman opens agency in Hawaii. . . . Pitcairn flies first autogiro in America. . . . Lockheed increases factory floor space to 48,000 sq.ft. . . . Marine Corps fights mosquitoes in Nicaragua by dusting. . . . Fokker announces sale of five 32-passenger, four-engine planes to Universal Air Lines. . . . L. E. Gale Co. of Hankow, China, orders twelve Kinner-engine *American Eagles*. . . . University of Wisconsin announces course in aeronautics. . . . Planter in San Salvador orders airplane for plantation inspection.

10 Yr. Ago (1934)—Japan builds "commercial" airport near Philippines. . . . Cook Agency offers round-the-world airplane tours. . . . Thirtieth anniversary of Wright's first flight celebrated. . . . Navy Bureau of Aeronautics gets $7,500,000 for new equipment. . . . Sperry develops portable 800,000,000 cp. anti-aircraft searchlight. . . . UAL cuts coast-to-coast schedule to 19½ hr. . . . Curtiss grants contract to U.S.S.R. for manufacturering *Cyclone* and *Conqueror* engines. . . . And the same company's engineers begin cooperating with the Chinese National Gov't. on a military airplane factory.

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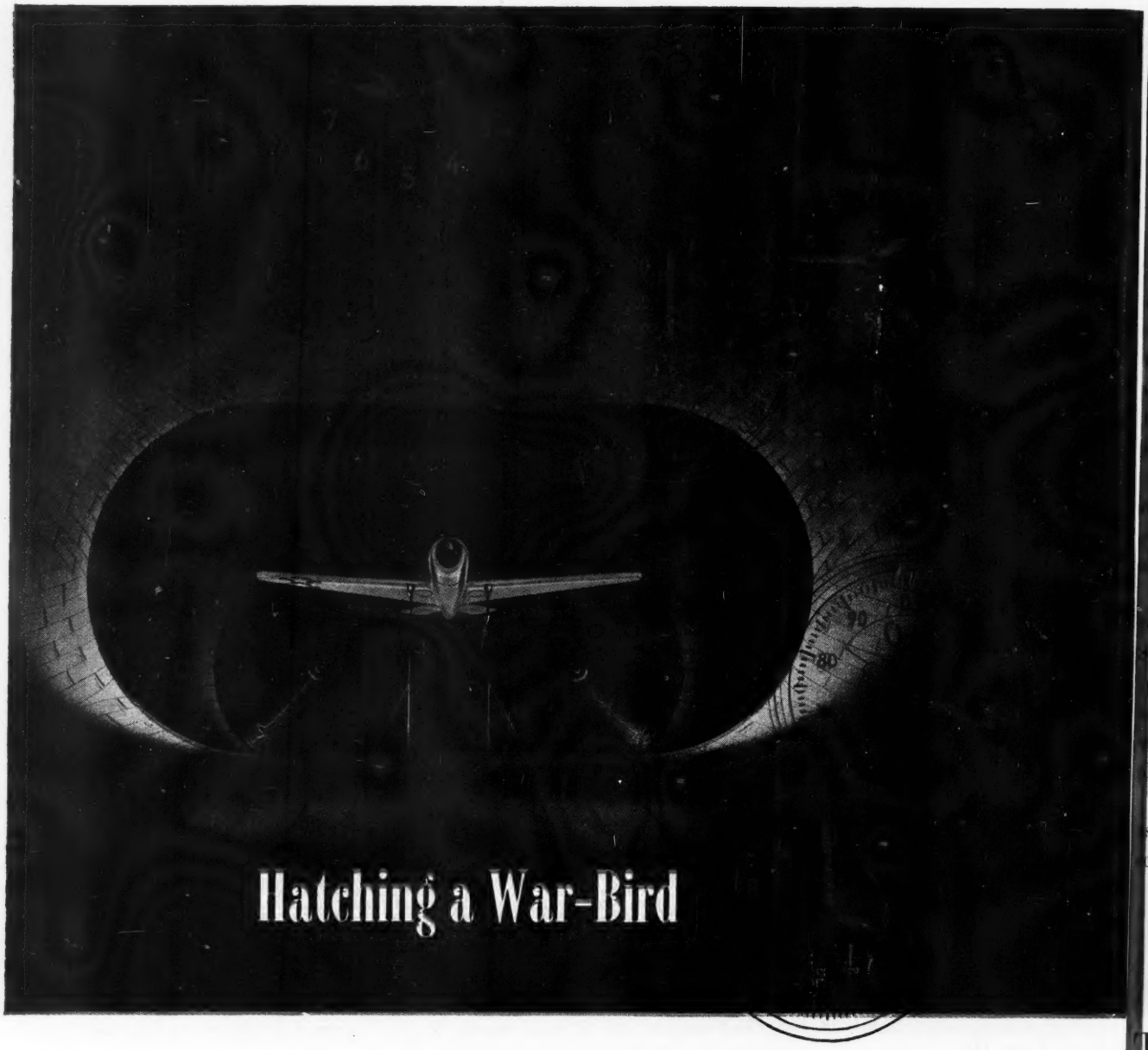

Hatching a War-Bird

THE majority of those who use and respect Kollsman aircraft instruments know them most intimately as sentinels on the airplane instrument panel, indispensable to the plane's precise and dependable operation.

But long before our war-birds ever get into service, many engineers certify their design and performance with Kollsman instruments in wind tunnels, engine test cells and in test flights.

Because of their accuracy, standard Kollsman instruments are found in frequent use for many forms of aeronautical experiment and in production testing. In addition, many special Kollsman instruments have been developed for these uses.

KOLLSMAN AIRCRAFT INSTRUMENTS

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Progress the *Employment* Way

AN INDUSTRY that can build an airplane every five minutes and more than 1,000 long-range bombers a month, is a splendid monument to industrial achievement. It is a part of a system of individual enterprise that has never been approached elsewhere in the world. But this miraculous industrial machine is due for some changes in thinking that it may not like—in order to avoid some developments that would be completely destructive to its efficiency. The old time rugged individualist is going to have to compromise, and in some cases it will hurt.

In the old days, one went into business to make profits, a motivation we hope will always continue. Sometimes the consumer was considered and, when he received what he wanted at ever decreasing cost, there was a definite effect on profits. But few people ever went into business primarily to keep workmen employed.

This is a new idea in industrial thinking, and all of us should get it through our heads that we'd better accept it or somebody else will.

One of the most interesting practical applications of this thinking is the postwar fixed-base operation now being set up at Parks Air College. This whole activity stems from a desire to provide continuing employment for present personnel and also for some part of the large group of returning servicemen. The morale building values of such an attitude on the part of management are readily apparent. Employees are eager to be selected for this work, even though it involves a considerable expenditure of their own time. This is the thinking behind the highly illuminating Parks survey detailed in our article, titled The Personal Plane Sales Target, beginning on page 116.

Admittedly it would be more difficult to work out similar solutions where employment had grown to incredible proportions. But whatever is done the approach to the problem must keep reasonable employment as the primary objective. Then, with the additional essential ingredient of government cooperation, reasonable returns in the form of profit may be expected to follow along.

Termination Begins at Home

THOUGH AIRPLANE PRODUCTION CURVES continue to leap upward and will maintain their upward trend after the manufacture of other war materials is cut back, it is inevitable that there will be a leveling off point and a drop in production at some time in the not far distant future. Much thought is being given in both government and labor circles to the problems of contract termination. Not enough is being done about this problem by industry.

Individual managements must decide whether they are going to sit back and wait for the procurement agency with whom they are doing business to come in and do the job for them or whether they are going to do the job themselves.

Contract termination work requires able direction and large groups of personnel trained in engineering and accountancy. If the procurement agency must do the job, it is faced with the choice of taking key personnel out of plants, where they should be, or of struggling along at a hopelessly slow pace. Neither alternative is desirable.

Every military contractor should set up in his own organization an adequate force of specialists to study the problems of termination of his contracts, working toward a program for the orderly deceleration of activity and considering the impact upon the local community of the necessary reduction in labor force.

By having such a program ready before the cut-back comes much grief can be avoided for all concerned and precious time will be saved in getting back to peacetime levels of production.

Leslie E. Neville

EDITOR

AVIATION'S
WAR COMMUNIQUE
NO. 25

America at War

Germany's power of resistance sags under grim airblows . . . . War enters superweapon stage, but impression of these innovations will be small in the total picture . . . . Allies' power augmented by technological improvements.

GERMANY'S REPORTED shift from offensive air tactics to a defensive-fighter program has failed. The shift might have worked with great damage to the Allies if the enemy's plant capacity and manpower had continued to grow, or even to remain intact. That is where the unphotographable dividends of RAF-AAF bombing of Europe show up—at last. The Nazis' plane production capacity has been partially throttled by plant demolition and displacement of workers whose homes and services have been eliminated.

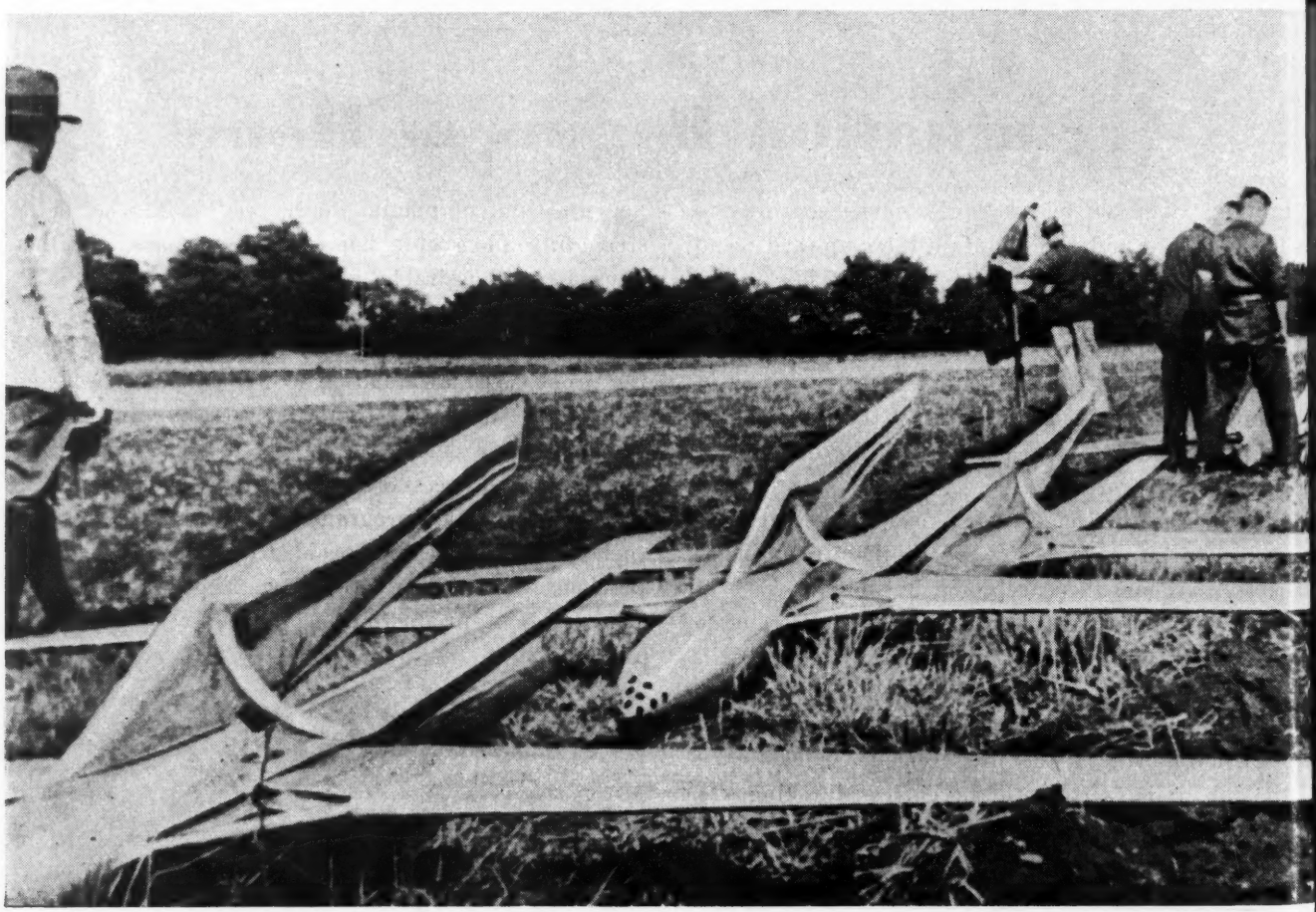
So Goering doesn't have enough fighters to turn back the Allied air assault upon his roofless European fortress. Putting several estimates together, you conclude he has about 2,000 on his east front against Ru sia, and another 2,000 in the west to battle the Amer cans and the British. That is not nearly enough t stop the Allied attack, but it is enough to take a terrib toll for some time to come.

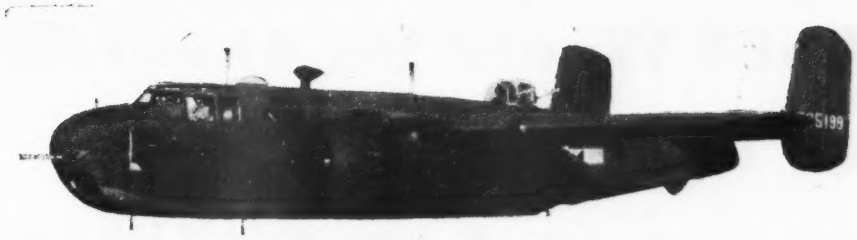
No one, not even commanders of enemy and Allie powers, can pretend to know just how long. The wa can be ended by Germany's failure to build enoug fighter planes, or by any number of other causes whos workings can't precisely be foreseen.

One writer in London has taken pencil in hand an figured that 17 of Germany's 38 major industrial cen ters have been "knocked out" by bombing. "Knocke out," however, is a pretty strong expression. An another man—one who talks with generals and wa producers from all over the world—said recently tha only three or four Nazi strong points had been knocke out.

Chances are that every industrial and communic tions center in Germany, even those that have bee

Nazis came up with "radio controlled" glider-bombs for use against Allied bombers. These weapons were fearsome enough on first use, but continued effectiveness has not yet been fully appraised. At any rate, glider-bombs certainly haven't stopped our bombing offensiv Nazis may have patterned winged projectiles after Tiling powd rockets (below) devised about 1930. (International News photo





Mounting 75 mm. cannon as well as two .50 cal. machine guns in nose, this North American B-25 *Mitchell* is now operating with considerable effectiveness against surface ships and installations.

At left, Jap destroyer is seen smoking after attack by North American B-25 equipped with the 75 mm. cannon. **Right:** Arrow points to damage caused by 75 mm. shell.

given the "Hamburger treatment," are still functioning to some extent. Of course when the production of a nation at war stops going up while that of its enemies continues up, the end is in sight. That is the one thing you can say for sure about Hitler's war.

Most, but not all, of those who should know, now discount completely any prospect of a Luftwaffe attack in force anywhere. The Germans are not just cowering under the fire and concussion that rains on them from aloft. They are furious. And if it were possible by any stretch of effort, they would hit London in force. As soon as the Allies occupy cities in Norway, France, the Low Countries, and Northern Italy, all within closer bombing range, they will be potential Luftwaffe targets. Hitler still has a force of bombing planes, is undoubtedly maintaining service facilities, and is holding them for emergency use. But they can be used for only a few wild punches. Germany's bomber production plant appears to be out of business and replacements are doubted.

Germany first lost the air battle of England, then the battles of Africa and Russia, the submarine war of the Atlantic, and lastly the air defense of Europe. Next loss will be Hitler's "Superman" weapon campaign. Glider bombs and rocket troughs aimed at

(*Turn to page* 313)

"Lay that pistol down" is being feverishly sung by Jap seamen. Close up of B-25's gun installation shows why.

What I Would Do About Reconversion

By **DONALD W. DOUGLAS**, *President, Douglas Aircraft Co.*

Mr. Douglas faces hard facts in his statements concerning reconversion of the aircraft industry from military to postwar activity. Presented herewith are specific suggestions for solving the problem with materials and opportunities at hand.

RECONVERSION OF AMERICAN INDUSTRY back to its normal life after this war is a national problem in which industry alone cannot play the deciding role. The government, with its vast powers and controls over the lives and acts of individuals, groups, and industries, must shape and approve the blueprint of a sound and constructive program for the postwar period.

Industry, with its background of experience and technical knowledge, has the duty to advise and suggest. This duty it owes to its employees and to the nation. In turn, industry has the right to expect that the government will promptly and intelligently provide its share of the solution, also that its contribution will be built on the American principles of fair play and equity. The aircraft industry has earned that right—by completing in record time a job of unprecedented proportions and by helping give this nation in a few brief months the greatest air force the world has ever seen.

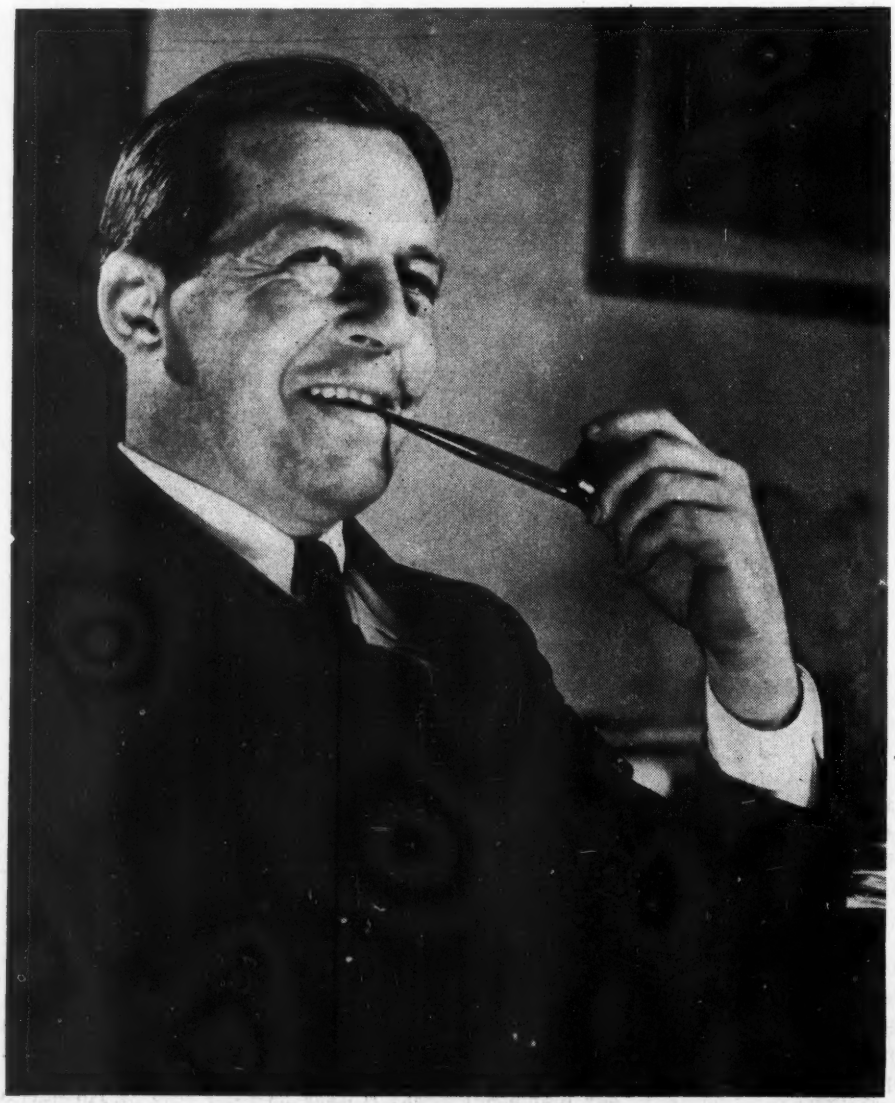
When we were suddenly plunged into war, there was no time to stop and think about the future. The national crisis demanded immediate action. With little warning, without much preparation, the aircraft industry was told to produce 50,000 planes a year. Then the figure was increased to 75,000 . . . to 100,000. The assignment was a staggering one, but the industry threw aside every consideration, except accomplishment of its task, and today it is performing on schedule everything the nation asks it to do.

In time of peace as well as war, a sound and efficient aircraft industry is an asset to the nation. Without such an industry, functioning and prepared instantly to increase its output, the skies over America would have been much gloomier and threatening the day war began. Every American knows it is our national duty to preserve the aircraft industry as an indispensable instrument of national safety.

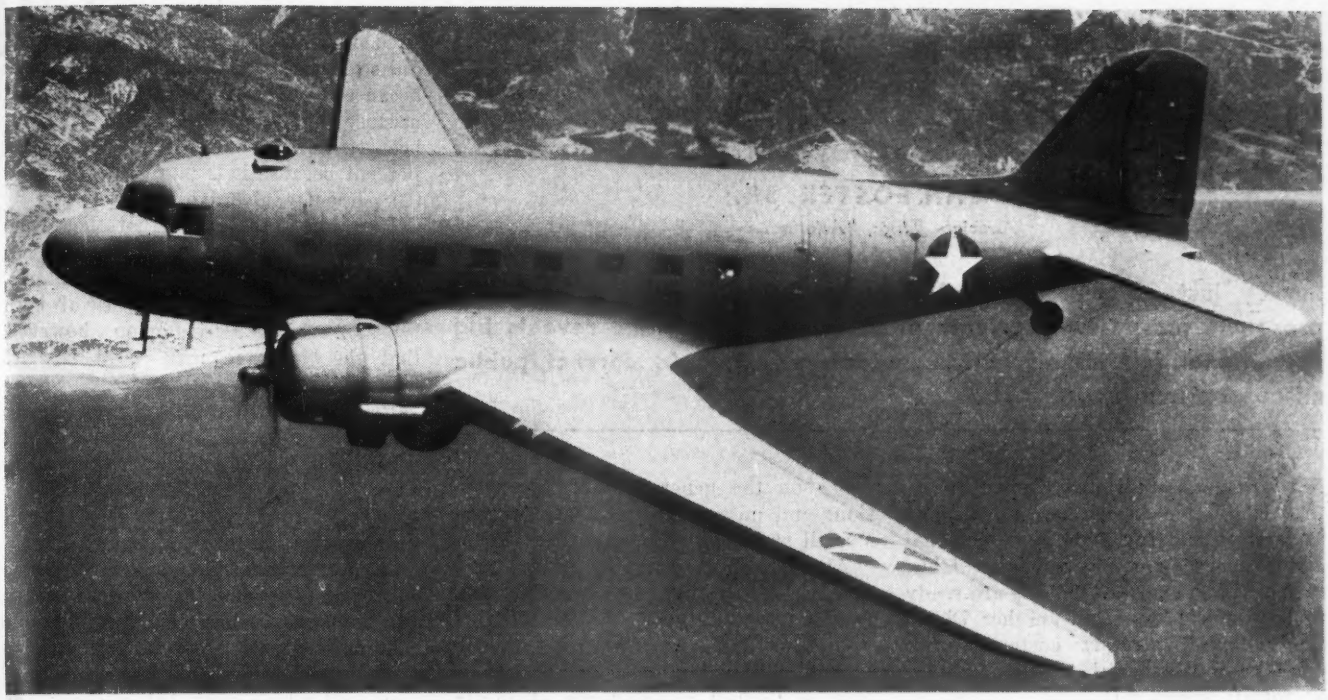
Combat and cargo airplanes of the highest quality today are flowing from our production lines in a great and overwhelming stream. The war has not been won—but the skies are no longer dark. The job of production is well in hand. Now we can begin to consider the future—the price that must be paid for this job in readjustments and reconversion and the things that must be done to carry on from where we left off.

When a reporter asked me recently what would happen if the government abruptly and without notice cancelled all contracts, leaving no work to be done, I gave him the only true and logical answer—"When there is no work in the shop, you have to shut it up." This is a hard fact, not a theory. It is a condition, not a plan. The job of planning is a joint venture. All of us must participate in postwar planning.

We, as a company and as a part of a great industry, have been giving much thought and will continue to do so, but the American people must realize that the world of tomorrow must be reconstructed carefully, soundly, and with due regard to our national welfare and destiny. And realizing it, I hope they will ask Congress to take it in hand and provide just and wise solutions, based on equitable decisions and on readjustments that are fair and constructive.



Donald W. Douglas



"Lease C-47's to the airlines temporarily, then distribute them among worthy allies."

My idea, and I am sure that it is shared by many other aircraft builders, is that when the time comes, contracts should be tapered off and employees released gradually, at a rate that will give them an opportunity to find their way back into normal, expanding American industrial life.

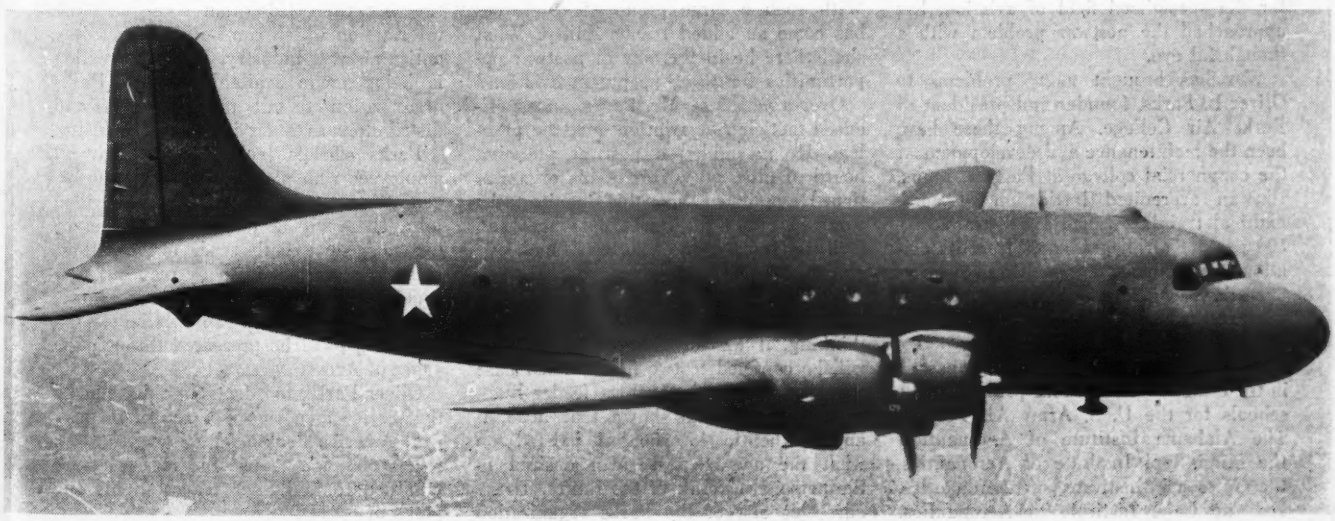
Of course, a problem would remain for aircraft producers and professional aircraft workers when the last of our purely military contracts were cancelled. And the answer would depend on what the government would do with the thousands of transport planes which have been built for the vital task of shortening our worldwide military supply lines.

Douglas Aircraft alone has delivered to the Army thousands of C-47's since Pearl Harbor, and deliveries are increasing monthly. At the same time, the entire production capacity of our Chicago plant, as well as an assembly line at Santa Monica, are being devoted to mass production of giant *Skymasters*, four-engine C-54's.

As far as the Douglas Aircraft Co. is concerned, my personal suggestion would be for the government to lease to the airlines, immediately after the war, such C-47's as would not be required for postwar policing and reconstruction. At the same time it could turn back to us a number of *Skymasters* for conversion to passenger planes. Then, when the conversion job was finished, the government could sell the C-54's to the airlines and take back the leased C-47's for disposal, as the government would see fit, to some worthy ally. China, for example, will be in drastic need of airplanes for her tremendous task of reconstruction and industrialization, and if she were given help in starting nation-wide airlines, she would become a great future market for American-built airplanes.

Government-owned plants present a grave problem, but one that is wholly under its control and is the government's responsibility. It is quite obvious that as great as will be the increase in commercial air transportation after the war, that market can not possibly absorb more than a fraction of the production capacity which has been built up to meet our war needs. In fact, there will be stiff competition between prewar producers for sufficient business

(*Turn to page* 306)



"Reconvert C-54's for passenger service and sell them to airlines."

The Personal Plane Sales Target

By JOHN FOSTER, JR.,
Associate Editor, "Aviation"

Survey just completed for Parks Air College sees 78,000 "hot" prospects for postwar private plane, but at same time reveals big educational job all aircraft manufacturers face to correct public misconceptions.

WHILE an indicated 78,000 financially-able Americans plan to pay at least $1,500 for a postwar personal airplane as soon as the craft is available, half again as many—119,000—are ready to buy helicopters. And another 78,000 are potential aircraft customers but don't know whether they will buy fixed or rotary wing craft.

The groups represent 1 percent, 1½ percent, and 1 percent, respectively, of the financially-able 6 percent of the population who today may be unqualifiedly considered sound sales prospects.

Such are the principal conclusions reached by analysis of the first completed personal plane survey, conducted in nine large eastern, midwestern, and southern cities for Parks Air College by Edward G. Doody & Co.

The study, which was ordered to develop information to guide Parks' two postwar planning committees, revealed what is perhaps the first tangible evidence on the general public's conceptions and misconceptions of fixed wing as well as helicopteral aircraft.

Analysis of the complete survey may well serve to point out clearly to producers of both types of aircraft just what educational work must be done to secure additional potential customers as well as to "set right" those obviously misinformed people who can be easily shifted from prospects to sharp critics.

The outstanding reason for preferring the helicopter, for example, was "because it is easier to land and park," with 35.5 percent of those choosing it giving that as the basis for their choice. Next in importance was a group comprising 21.6 percent who feel it to be safer; followed by 20.1 percent who "feel it is easier to operate;" 16.3 percent who "have a personal preference;" 2.1 percent who believe "it is cheaper to operate;" and 1 percent who could give no reason for their choice.

Of those who definitely preferred the fixed wing type airplane, 31.4 percent did so because it is faster; 17.2 percent because they felt it is safer; 17.2 percent because it is better known; 14.1 percent because of a personal preference; 11.1 percent because it is more efficient; and 9.0 percent could give no reason.

It would thus appear that those who preferred fixed-wing aircraft had, on the whole, a better knowledge and understanding of the capabilities of both types of vehicles. It is obvious, however, that the "average man" still harbors many illusions on both types.

Prime function of the survey was to arrive at answers to two questions: First, who is going to buy "the family car of the air?" (labelled that for want of a better term); and second, what will they expect this machine to be?

In determining the answers to these two basic questions, interviewers used a questionnaire which had a possible maximum of 25 answers, which also served to develop additional information, and which provided a check for analyzing some of the answers given on other portions. Interviewees were restricted to men and women—in a ratio of five to one—who comprised the 6 percent of the population earning $75 or more per week; they comprise the group generally accepted as being financially able to purchase and maintain aircraft. The greatest percentage were about 40 yr. of age, although samples were broadened to include men under 30 and those up to 60 yr. of age.

The survey included 100 interviews each in Atlanta, Ga.; Columbus, Ohio; Dallas, Texas; Indianapolis; Kansas

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• PRESENTED HERE is what one organization, keenly alert to aviation's future, is doing to make postwar job opportunities possible by developing new enterprises.

Parks Air College, now in its 17th year of service in the education of young men for the specialized field of aviation, has approached the postwar problem with a thoughtful eye.

War has brought many problems to Oliver L. Parks, founder and president of Parks Air College. Among these have been the maintenance and development of the commercial college at East St. Louis, Ill., an accredited institution of aeronautical training. Since 1934, practically 100 percent of all graduates from its aviation maintenance engineering, aviation operations engineering, and aeronautical engineering courses have gone directly into the aviation industry.

Further milestones have been passed in the establishment of four primary flight schools for the U. S. Army Air Forces: The Alabama Institute of Aeronautics, the Mississippi Institute of Aeronautics, the Missouri Institute of Aeronautics, and the Cape Institute of Aeronautics.

With a full-fledged primary flight program also in effect at Parks for the Army, and the five schools training some 10 percent of all Army Air Forces Cadets, Oliver Parks has watched his normal college personnel of 100 approach the figure of 1,500. With such a large group of employees has come an added responsibility: What shall there be in the way of postwar opportunities for these people in aviation?

Over a year ago, Mr. Parks, an experienced tactician in aviation, met the problem. He assembled a postwar planning board of nine executives of his organization. He assigned them this definite task: Find an outlet for Parks personnel and facilities in aviation at the war's end.

After months of research and field trips, with each executive pledged to devote 20 percent of his working time to postwar thinking, it was decided that operations will be confined to two fields—fixed base operations and air transport feeder lines.

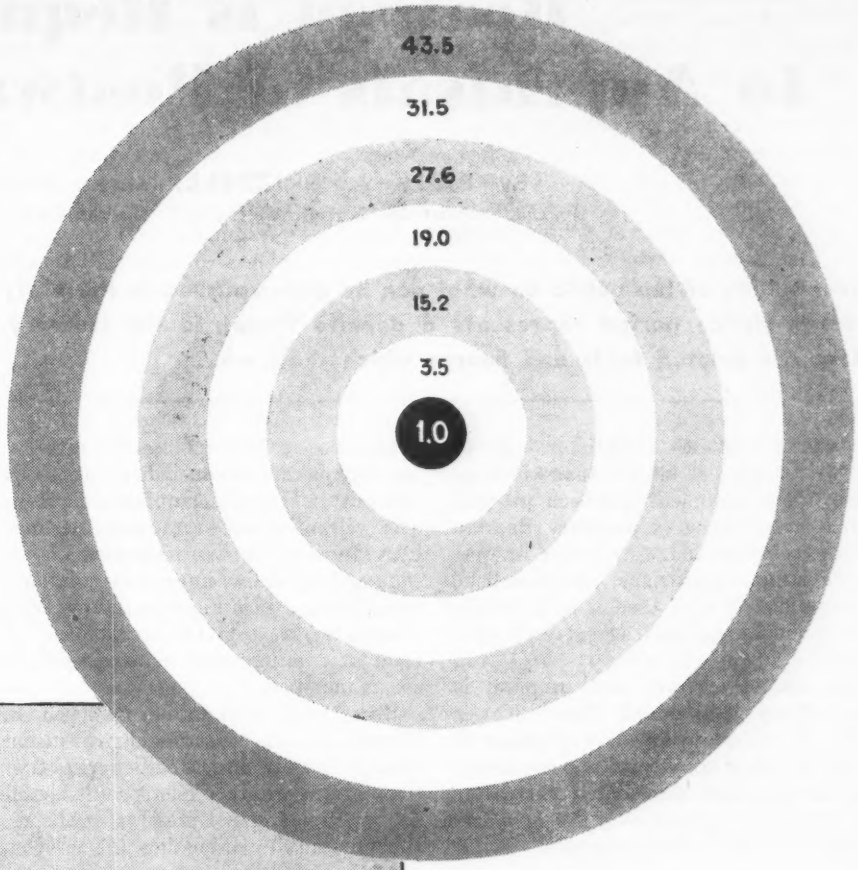
Investigation had shown that little, if any, authentic information existed on what the average American desired in the personal aircraft of the future. To secure this answer the Parks organization commissioned Edward G. Doody & Co., research organization, to make a survey which could serve as a guide in making plans for the sale and service of private aircraft.

The results, presented in detail here for the first time, bring out some startling information which can be of value to the entire aircraft industry. This information is being made available by the Parks organization to all manufacturers and distributors as a service to the industry.

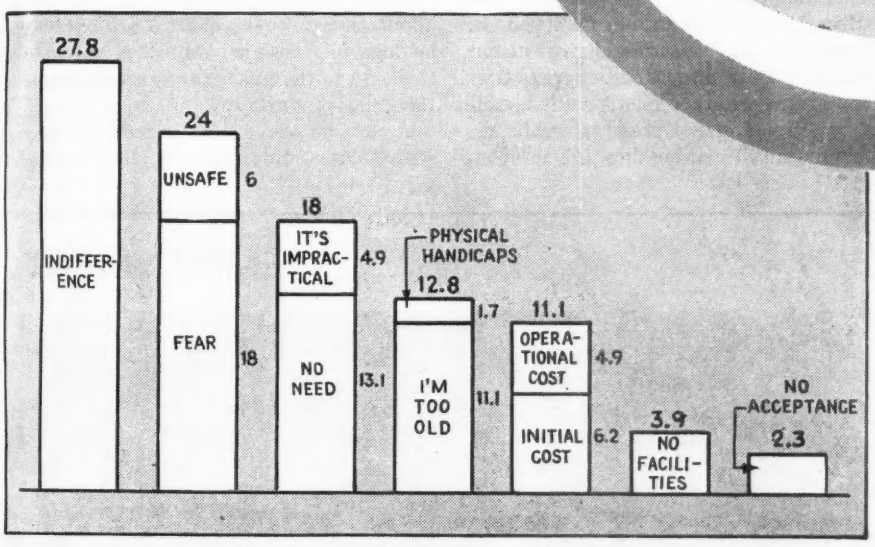
Parks officials feel confident that all employees who plan to stay with the organization after the war will be provided jobs. These will be jobs offering a chance to grow, since both types of operations planned represent, in many respects, new ventures. Detailed discussions of these plans—some of which can only be classed as daring—will be presented through the pages of AVIATION.

Oliver Parks, too, feels an obligation to the service men who will return to postwar America looking for opportunities. He is planning to use the men who are qualified to find their places in his two plans of operation.

Here's personal plane manufacturers' sales target, as revealed in survey made for Parks Air College by Edward G. Doody & Co. Outside ring represents 43.5 percent of financially-able people who can be considered potential buyers of some sort of aircraft. Next ring—better prospects—shows 31.5 percent who expect to buy and pay at least $1,500. Third ring shows 27.6 percent unconditionally ready to buy when given all facts, contrasted with 19 percent in next group who already have facts and are willing to buy. Next smaller ring represents 15.2 percent who are satisfied with specifications outlined in questionnaire. The 3.5 percent group will buy fixed-wing plane or helicopter as soon as possible; the 1 percent bull's-eye are those who are set to buy plane as soon as it's available.



These are the stumbling blocks to personal plane sales. Survey showed many people give definite reasons for saying they won't buy aircraft—with complete indifference, fear, "lack of appreciation," and lack of self-confidence all ranking ahead of objections to purchase price or operating costs.



City, Mo.; St. Louis, Mo.; and Pittsburgh, Pa.; 200 in Chicago; and 250 in New York City, for a total of 1,150.

In answer to the question, "Do you intend to buy an airplane or helicopter after the war?", 43.5 percent said "Yes." Of this group, however, 45.3 percent predicated the "yes" on some contingency. Price loomed as the most important, with 42.7 percent giving it as the contingent factor. Next most important "if" concerned the aircraft's utility, for 15.9 percent said they would buy only if either the plane or the helicopter was "practical." Definitions of the word practical covered a wide range—depending almost entirely on the individual's own needs, desires, or conceptions—a range so wide as to preclude accurate measurement.

Safety as a contingency ranked next in importance, with 14.1 predicating their "yes" on that factor. Other measurable qualifications were these: If the interviewee could learn to fly, 9.4 percent; if the general public accepted the idea of "the family car of the air," 7.6 percent; if adequate landing and storage facilities were available, 5.4 percent; and miscellaneous contingencies, 4.9 percent.

Perhaps as important was the fact that the survey revealed definite reasons why people do not intend to buy either planes or 'copters, with complete indifference ranking first in importance at 27.8 percent. What might be interpreted as an additional "indifferent" group—totaling 18 percent—were those listed in the survey as having a "lack of appreciation." This group was broken down into 13.1 percent who said they could get along without a flying machine, with the other 4.9 percent declaring that aircraft—both fixed and rotary wing—are not practical.

Fear still ranks as an important sales block, for it accounted for 24 percent of the negative answers, with 18 percent stating flatly that they were afraid to fly and 6 percent saying that aircraft are unsafe. Lack of self confidence accounted for another 12.8 percent of the "no" answers, with 11.1 percent indicating they felt "flying is a young man's game" and 1.7 percent believing themselves to be physically unfit.

Fifth most important reason for negative answers was cost, with a total of 11.1 percent, divided into 6.2 percent objecting to initial cost and the other 4.9 objecting to operating and maintenance costs. Only 3.9 percent based their "no" answer on the absence of landing and service facilities and 2.3 percent on the lack of public acceptance.

An indication that education can easily overcome at least part of the objections and convert people into prospective buyers was given in a card-question containing a list of 22 features being considered for proposed postwar personal planes. After checking the specifications listed on the card, 4.1 percent of those who had said they did not intend to purchase indicated they would become purchasers if the craft had all or most of the features listed.

This question also served to determine the features or characteristics most desirable, since all interviewees who first said they did not intend to buy were

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Realism is Requisite In Appraisals of Postwar Aviation

By **PAUL J. FRIZZELL,** *Assistant General Manager*
Fairchild Aircraft Div. of Fairchild Engine & Airplane Corp., Hagerstown, Md.

Over-selling of the public on what can be accomplished in the early post-armistice period represents a definite threat to the industry. Here are printed facts and figures which show why.

EVER SINCE the inception, just 40 years ago, of heavier-than-air aviation, its development has been plagued by a certain form of parasite. Because of the romance and wide public interest in aviation, politicians, industrialists, and publicists have used it as a vehicle for personal aggrandizement and publicity.

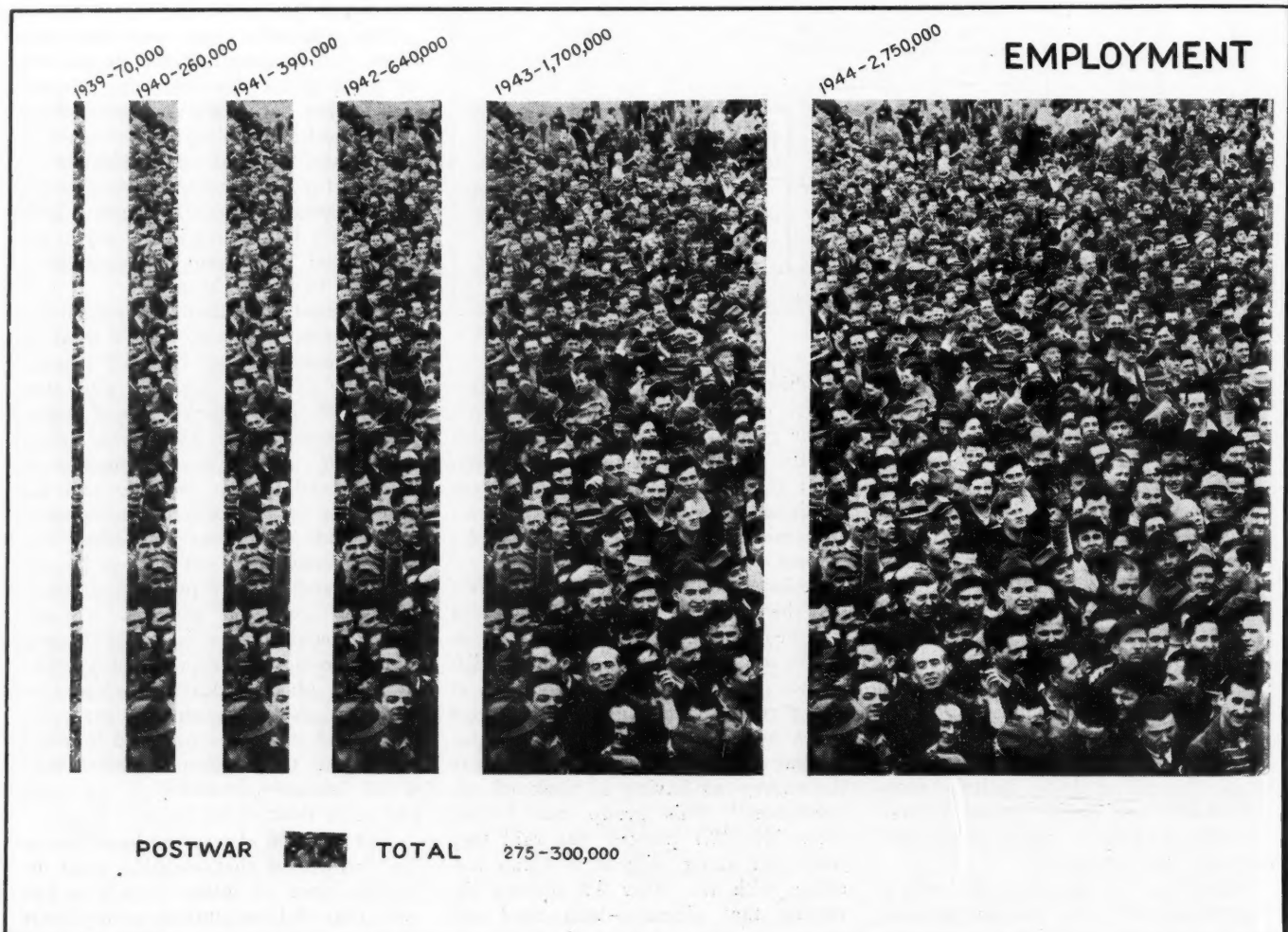
A relatively recent case in point is that of my good friend, Henry Kaiser who, it will be recalled, was going to develop within six months a cargo-carrying aircraft and immediately thereafter produce it in quantities sufficient to replace surface overseas transport.

Other cases in point are the advertising campaigns conducted by those in and out of aircraft manufacture. However well-intentioned these activities may be, to those of us possessing some knowledge and a genuine interest in aviation's development, such representations offer a definite threat to the sound development of aviation, both as a science and as an industry.

Recently I attended a luncheon in Washington at which high government officials were to discuss with representatives of the aircraft manufacturing industry some of its postwar problems. But instead of discussing the subject, those officials severely castigated the industry for diverting any part of its time or energy to the consideration of postwar problems.

I have no illusions about either the severity or the length of the war in which our country is engaged, but on the other hand I gladly defend and justify the determination of the aircraft manufacturing industry to prepare itself for what lies ahead. Its record offers adequate proof that such preparation is not being made at the cost of its war effort. If, as it appears, we are making progress toward the winning of the war, I think any fair-minded person will admit that a great share of the credit belongs to American industry, and particularly to the American aircraft manufacturing industry.

As can be seen from figures to be presented later, this industry has become



a giant in our industrial scene. If for no other reason than its size, it has a responsibility and a duty to plan as best it can for the peace. Historically, democracies enter wars unprepared, and our own record prior to Dec. 7, 1941, conformed to the historical pattern. If we enter the peace similarly unprepared, then what will follow will make any victory a hollow triumph.

But aviation and its people have an even larger responsibility for, despite the fact that it has been perverted to destruction and war, the science of aviation is capable of making a contribution to man's inexorable progress that challenges the most imaginative mind. Properly developed, it will shape the destinies of children not yet born.

First, it is advisable to discuss aviation's potential in the several categories of its application, and then to summarize the result on the aircraft manufacturing industry which that potential will exert. In speaking of postwar, it should be made clear that this means the period of three to five years from the end of the war. It would be a brave man indeed who would undertake to define aviation's progress beyond that point.

Postwar aviation will fall into three broad categories: Military, private, and commercial. Because of the nature of the global war in which we are engaged —utilizing as it does every form of aircraft from the 65 hp. light plane used for liaison and artillery spotting to those battleships of the sky such as the *Flying Fortress* and its successors of even greater size and power of which you will hear much in the coming year— I would be a pessimist indeed if I failed to recognize the tremendous acceleration which the crucible of war has provided to the entire science of aviation.

In materiel, technology, and personnel, war has brought experience in months that would normally have required years to gain, but we should not forget that we will end the war with an air force far greater than required for any conceivable peacetime need including any possible international air police force. Let us not forget also that in the past the American public has been very loath to support any substantial military establishment in times of peace. While I believe that we have learned our lesson to a degree and will recognize that the best assurance of future peace is a demonstrated ability to wage war, it would certainly not be the part of realism to expect military aviation to be a substantial factor in the postwar picture.

It is probably in the field of the private or personally owned aircraft's future that the greatest divergence of opinion is in regard to postwar utilization. As a result of recent publicity and advertising, I am very much afraid that many Americans have the sincere belief that on the morning after the armistice is signed they will be able to call Sears, Roebuck or some local agency and order for that afternoon's delivery a helicopter with lavender upholstery and with their initials on the door in shaded gold. I have a tremendous faith that someday the helicopter or some other form of rotary wing aircraft is going to revolutionize our way of living and our way of thinking, but in my nontechnical judgment we have a long way to go.

That this type of aircraft has been brought even to its present stage of development is a tremendous achievement. Even if it does not progress beyond that point, it is a monument to the 25 yr. effort that Igor Sikorsky, a great scientist, has devoted to its development. There is no doubt that it will be developed beyond its present stage, but those who may be familiar with the problems of gearing will recognize that the control of the rotor and the stresses that are built up in its blades, having as they do a tip speed of approximately 350 mph., provide a staggering amount of work

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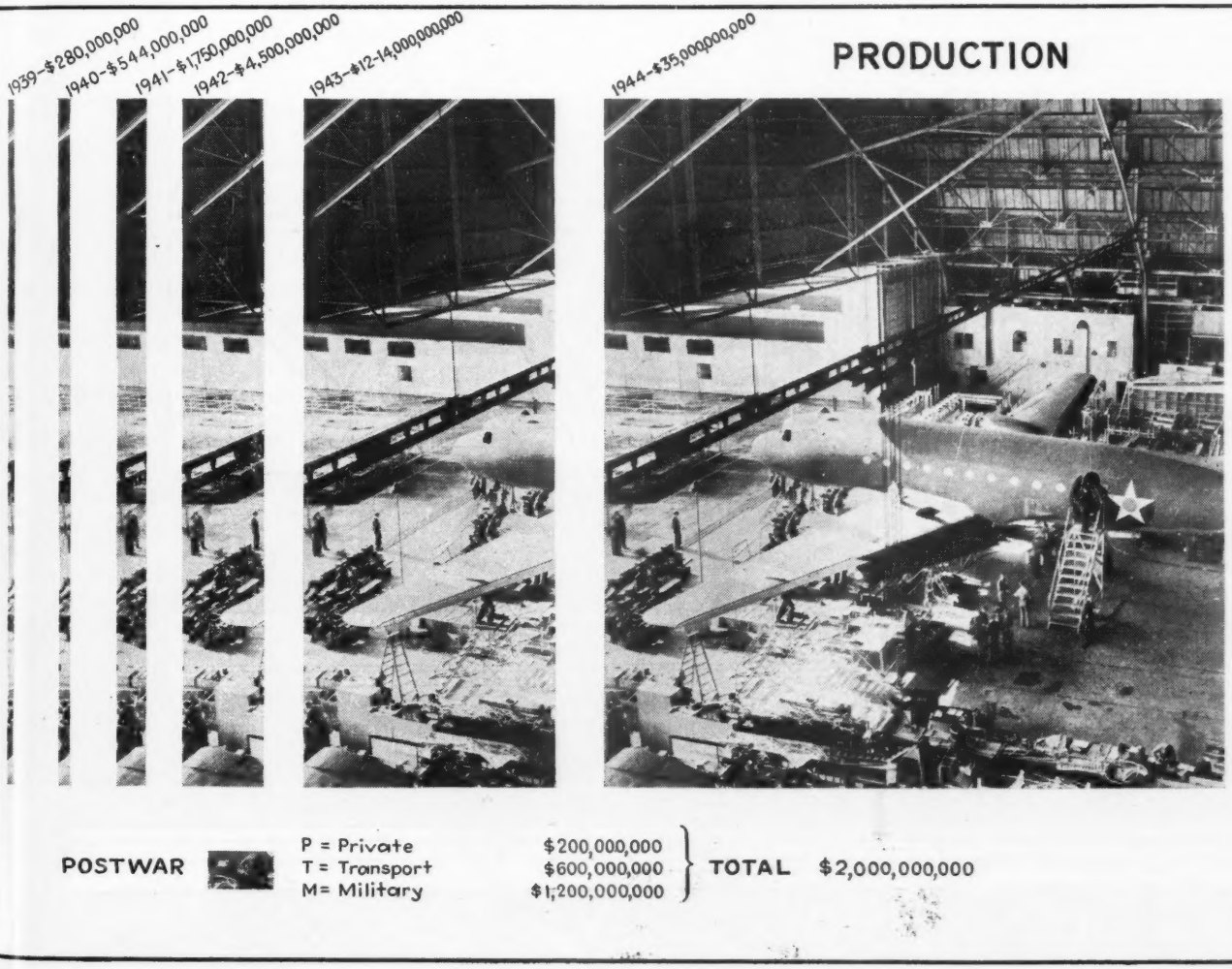


A Landing Gear "Yardstick" for POSTWAR AIRPORT LAYOUTS

By J. H. GEISSE, *Civil Aeronautics Administration*

Should plane design determine airport layout — or should airport factors determine plane design? Citing this choice in the light of the logical limitations, the author offers a key approach which accents the need for airfield accessibility and economy.

WHAT TYPE OF SKY PORT are we going to have in the future? That is a most important question, and to examine the factors specifically, let us refer to the accompanying Figs. 1, 2, and 3.

Shall we choose Airport No. 1, requiring 553 acres, with 257,000 sq. yd. of runway and 60,000 sq. yd. of taxi strips, and capable of handling six takeoffs and landings per hour* . . . . Airport No. 2, requiring 79 acres, with 88,000 sq. yd. of runway and 30,000 sq. yd. of taxi strips, and capable of accommodating six takeoffs and landings hourly . . . . Or Airport No. 3, requiring 146 acres, with 176,000 sq. yd. of runway and no taxi strips, capable of handling eight takeoffs and landings per hour and offering an approximate 10 min. reduction in the total ground-time for each schedule?

The choice lies largely with the airlines and the aircraft manufacturers.

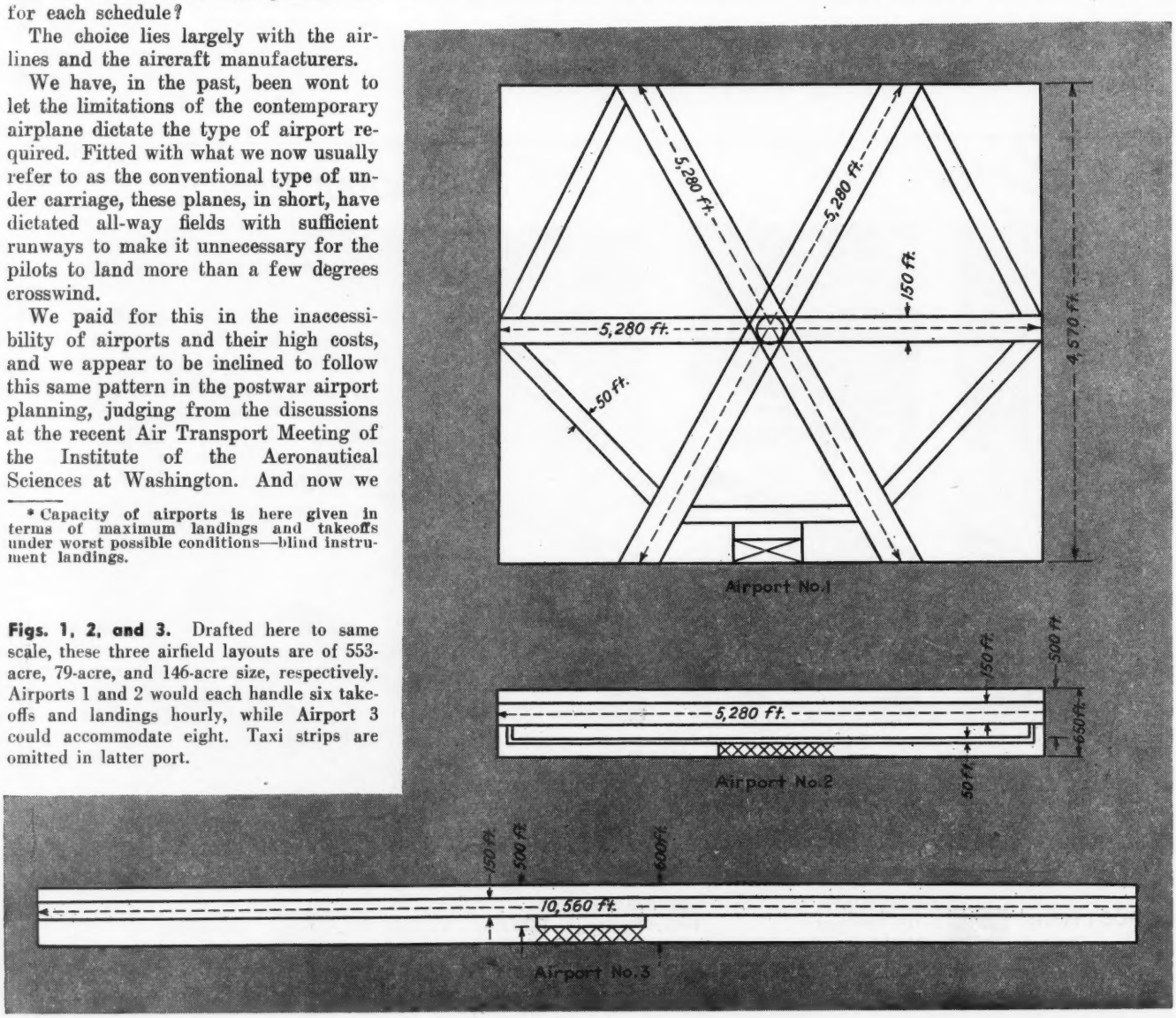
We have, in the past, been wont to let the limitations of the contemporary airplane dictate the type of airport required. Fitted with what we now usually refer to as the conventional type of under carriage, these planes, in short, have dictated all-way fields with sufficient runways to make it unnecessary for the pilots to land more than a few degrees crosswind.

We paid for this in the inaccessibility of airports and their high costs, and we appear to be inclined to follow this same pattern in the postwar airport planning, judging from the discussions at the recent Air Transport Meeting of the Institute of the Aeronautical Sciences at Washington. And now we contemplate paying the price of Airport No. 1, which is just about as high in acreage and similarly inaccessible, while being only slightly less costly in runway and taxi strip paving than the all-way field of the past. In short, little is being gained.

The author believes that the time has come to let the limitations of the airport dictate airplane design instead of the opposite and to modify our undercarriages to meet the limitations of single runway fields. It is his belief that this can be done quite readily without sacrificing any of the performance of the airplane or materially increasing its cost.

The problem presented in crosswind landings is only that of aligning the runway, the flight path, and the air-

* Capacity of airports is here given in terms of maximum landings and takeoffs under worst possible conditions—blind instrument landings.



Figs. 1, 2, and 3. Drafted here to same scale, these three airfield layouts are of 553-acre, 79-acre, and 146-acre size, respectively. Airports 1 and 2 would each handle six takeoffs and landings hourly, while Airport 3 could accommodate eight. Taxi strips are omitted in latter port.

plane wheels. With the conventional undercarriage, this presents a real problem to the pilot, since it is necessary for him also to align the airplane with the flight path and the runway in order to properly align the main wheels of the undercarriage. If he does not accomplish this, the airplane has a definite tendency to ground loop.

With the tricycle undercarriage, the alignment of the main wheels and the airplane with the path and the runway is accomplished after wheel contact by the directional stability of this type of undercarriage. However, this requires that the airplane be given a high rate of angular acceleration around its normal axis if the drift is appreciable. This is not only uncomfortable for the occupants but imposes a severe sideload on the main wheels. Because of this it seems to be agreed that Airport No. 1, providing a minimum of three runways, is required in the postwar area.

If we were to design our undercarriages in such fashion that the wheels could be aligned with the runway without the necessity of also aligning the airplane with the runway, crosswind landings would present no such problem. All that is involved in doing this is the provision of some mechanism which would make it possible for the main wheels to be set, or to assume an angle of yaw, relative to the airplane axes equal to the angle of drift. This is not difficult either in new designs or in modifications to existing undercarriages.

In new designs it is even possible that the weight of the mechanism required could be completely compensated by the reduction in undercarriage weight made possible by reducing the sideloads to which it could be subjected.

Advantages of such an undercarriage would not be limited to landings. By making the heading of the airplane relative to the direction of motion adjustable, it would be possible to eliminate another objectionable feature of airplanes wherein the heading and direction of motion must coincide. This concerns the need, in crosswind takeoffs, of a turn immediately after breaking contact with the runway, if the course is to be maintained in line with the runway.

If this is not done, the course will change immediately after breaking ground contact due to drift. Also, the ability to control, independently, the heading and direction of movement would make crosswind taxiing no more difficult than taxiing into the wind and would in addition facilitate the handling of airplanes in the hangars.

Most obvious solution of the problem is the undercarriage schematically shown in Fig. 4. Four wheels are shown in order to make the analysis applicable to both conventional and tricycle undercarriages, the addition of the fourth wheel having no affect on performance. With this arrangement all wheels would be turned simultaneously and in the same direction by control wheel *A* irrespective of the angle between the axes of the front and rear wheels.

Control wheel *B*, which would be connected to the present rudder pedals, would turn the rear wheels relative to the front wheels irrespective of the angle of the wheels relative to the airplane axes. Thus, control *B* would completely control the direction of airplane heading, while control *A* would completely control the direction of motion relative to the heading.

With such an undercarriage there would, of course, be some skidding of the wheels in a turn when the airplane was yawed relative to its path, the amount being proportional to the angle of yaw. This is shown in Fig. 5, where it will be seen that in yaw the axes of the extended wheels do not intersect at a common point, which is the requirement for a turn without skid. However, the author is inclined to believe that the amount of skid which would result from any degree of yaw likely to be required would not be too objectionable.

Performance of such undercarriages when the front or rear wheels are off the ground would be identical to the performance of the conventional gear, if the front wheels were contacted first, and to the performance of the tricycle gear if the rear wheels were contacted first, provided the degree of yaw of the wheels relative to the path is equal to the degree of drift, except for a slight increase in the yaw effects due to the

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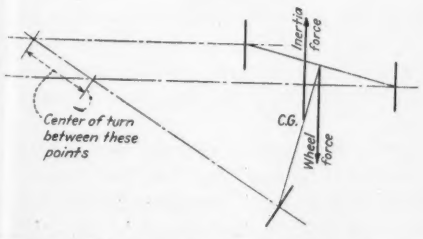


Fig. 5. Diagram showing location of center of turn with four-wheel gear.

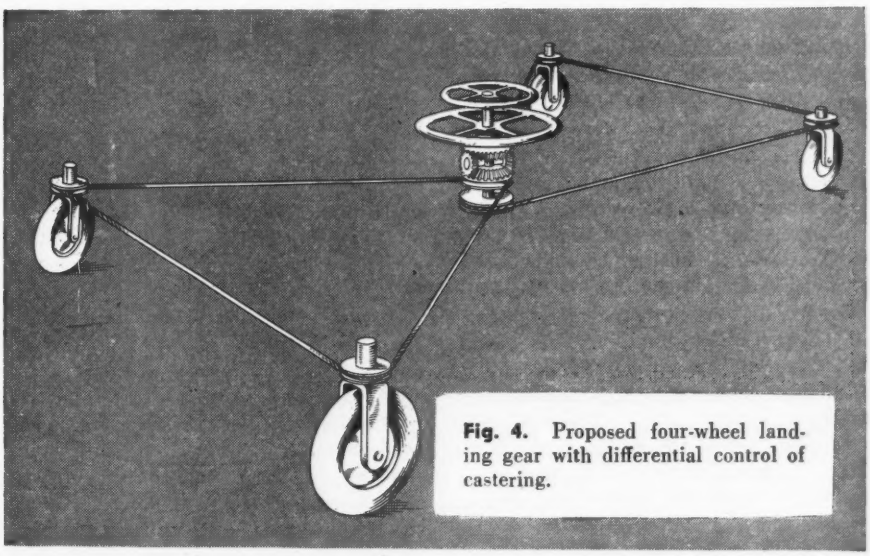


Fig. 4. Proposed four-wheel landing gear with differential control of castering.

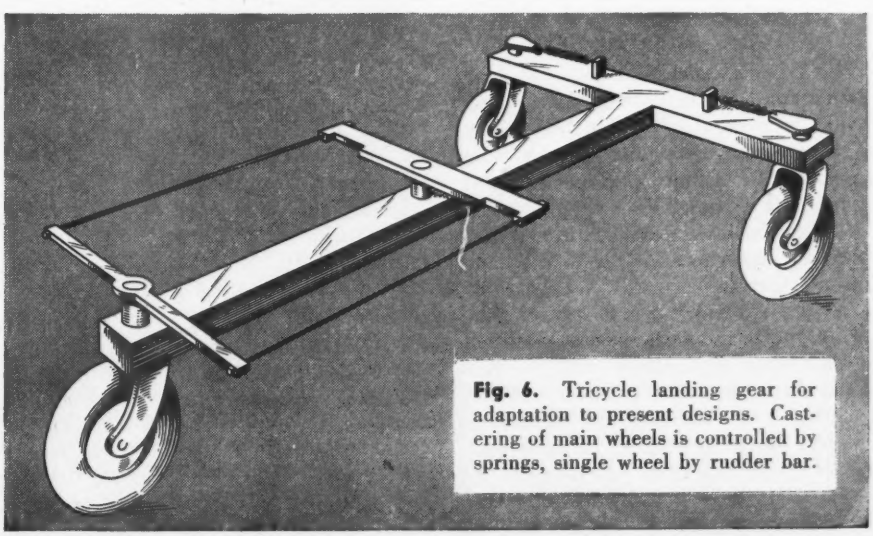


Fig. 6. Tricycle landing gear for adaptation to present designs. Castering of main wheels is controlled by springs, single wheel by rudder bar.

Beam of Sunshine Pierces Termination Clouds

By RAYMOND L. HOADLEY, *Financial Editor, "Aviation"*

Naming of Bernard Baruch means order instead of chaos which has threatened aircraft industry's existence . . . Here is outline by which manufacturers can do their part to bring well-regulated reconversion.

BARNEY BARUCH demands speed in contract termination payments. And speedy settlement of war contracts, of course, is the aircraft industry's desperate need if it is to stay in business after the war.

That's why the appointment of Bernard M. Baruch to head up postwar adjustment is a real "break" for the aircraft industry. Indeed, it's the first break the industry has had out of Washington's chaotic termination situation made up of dozens of war agency reconversion formulas, Congressional investigations, and bureaucratic jealousies over postwar power.

War contractors, big and small, have trekked Capitol Hill to complain how they have waited from 6 to 18 months to receive payment for cancelled contracts. No one in Washington could explain the delay. But it didn't take Baruch long to find out why. It seems that no one had tried to set up a uniform method of payment. It is his idea to evolve a method that will protect the government, yet give speed and final decision which can be opened up only in case of fraud.

And there must be a uniform plan—not one formula for the War Department, other different ones for the Navy, RFC, Shipping Board, and WPB. Furthermore, he wants one central organization to direct cancellation. This means that major policy will be worked out by Baruch as the traffic policeman on termination.

It also means the setting up of an interdepartmental council to arrive at uniform methods and procedures, headed, perhaps, by the WPB. There will probably be subcommittees composed of representatives of the agencies best equipped to execute termination within the policy boundaries.

It is Baruch's idea that the same agencies that did the mobilizing for the war should "unscramble" the many billions of war contracts which must be terminated—War, Navy, War Shipping Board, WPB and RFC.

Industry committees were used extensively by Baruch in World War I days. Quite naturally, then, he plans to link in WPB's industry committee machinery in the termination process whereby the industry committees will be consulted on termination procedure. When accepted by the agencies, the regulations should then be submitted to these committee representatives of industry to make sure they are workable and sound.

So industry generally should take the tip and make sure its committee representatives in Washington are well informed on termination, as well as capable of forceful presentation of industry's viewpoint.

But Baruch's big battle has been to consolidate all the different Washington ideas on termination so that they are uniform and make sense. As one industrialist who has waited a year for his cancellation pay summed up the situation, "We are not having any difficulty in the sense of there being any difference of opinion between the government and ourselves. It is merely that we cannot find on the part of the government any opinion at all, and we have been waiting a year in order to see if we could not let them define some position on what was proper and what was not proper. So far we have been getting nowhere."

Baruch is winning this first battle. The major procurement agencies are now really working together to evolve uniform practices for the first time. The possibility of over-all settlements on a company basis, rather than contract-by-contract, is being explored. These over-all settlements would be handled by the service with the dominant contractual interest. It is also expected that some arrangement will be made whereby prime contractors will handle the subcontractor problem, instead of the government's having to deal directly with nearly 1,000,000 subcontractors.

Thus it is Bernard Baruch's purpose, as his friends understand it, to build on the present machinery dealing with cancellation and to clean up the current "mess" by eliminating red tape and indecision, adopting uniform policies and procedures, and then achieving speedy termination—all from one central organization.

What about the plan of Comptroller General Lindsay Warren to have his General Accounting Office pass on all terminations? It was made plain to this writer that to one who is as impatient of red tape and delay as Baruch is—especially when such a critical matter as the successful reconversion of industry is at stake—the bringing in of an overworked outside government bureau to the termination picture would only serve to create another bottleneck in the speedy demobilization of labor and industry.

Baruch wants prompt final agreements on cancelled contracts—agreements that can be opened up only in case of fraud. That would surely indicate that Lindsay Warren's proposal will not be adopted by Baruch.

And that is also a break for the aircraft industry. Until Baruch was assigned the postwar adjustment task by the White House and Justice Byrnes, the odds were ten to one that Congress would adopt the Warren proposal. The General Accounting Office, it should be noted, is the creation of Congress, is responsible to Congress alone, and is entirely independent of the executive branch of the government. And in these days when Congress is so sensitive about its prerogatives, the Warren plan has definite appeal.

But Congress also has great respect for Bernard Baruch, and the heads of its special postwar committees have indicated their intention to cooperate and go along with him.

So this acute stumbling block to the termination process probably will be by-passed, ending a controversy that not only has had Washington boiling but which has also occasioned much alarm in the aircraft industry. Two groups of trained accountants, representing the contractor and the government service involved, already have to work on the settlements and certify the findings. Bringing in Warren's GAO would simply impose another group and add another step on the road to settlement.

Only last April, Warren told a Congressional committee that his present personnel was not adequate for the tasks it must do and that on Feb. 28, 1943, the backlog of unaudited vouchers had increased to 14,956,072. Furthermore,

War Department officials report that a check they made on the time usually required by the GAO on any disputed item revealed that the quickest such transaction had taken seven months.

Consider, then, the hundreds of thousands of war contracts that will need to be terminated. There are not enough accountants in the world, much less in the United States, to handle a thorough audit of all such contracts. That is the near-unanimous consensus of all prominent accountants who have voiced an opinion on the matter.

The Army has accumulated—the hard way—a lot of experience in handling its tank cancellations, and the Navy has likewise acquired some in its destroyer escort curtailment. This experience will be helpful, but Baruch fully realizes that industrial demobilization will be more difficult than mobilization proved to be. He knows that it will take time to make detailed termination blueprints.

But the procedure should be set up and starting to function rather smoothly by spring—before any substantial warplane curtailment will be in sight. So far, when aircraft orders have been cancelled, there were others waiting to be substituted. Other industries, for the most part, have had to bear the brunt of the confusion prevailing in early terminations.

The chief of the War Industries Board of 1918 is known to feel that the war mobilization task has been unsatisfactory in a number of important respects. It is Baruch's opinion that the two factors which saved industrial mobilization in 1941-43 were the Controlled Materials Plan, which stopped the hoarding of materials, and the labor control plan, which is checking the hoarding of labor.

Demobilization, he realizes, will be even more difficult. In mobilization, patriotism and national preservation were more compelling factors than they will be in the "unwinding" stage. He knows that termination got off to a bad start when there was comparatively little of it to handle. Recognizing these things and the other problems of postwar adjustment, he knows the size of his task to make demobilization machinery function smoothly and speedily.

Who are the men that Baruch is working with and consulting on postwar adjustment? We may say that the mere mention of some of their names shows that the problem is in the hands of business-minded men and that no social or political theory is likely to influence this process of restoring prewar democracy.

The right-hand assistant of Baruch is John M. Hancock, 60-yr.-old investment banker and partner in the New York firm of Lehman Brothers. The Lehman firm has been closely identified with the aviation industry since the early 20's. Hancock previously worked with Baruch in drawing up a solution for the West Coast's aircraft and shipbuilding manpower tangle.

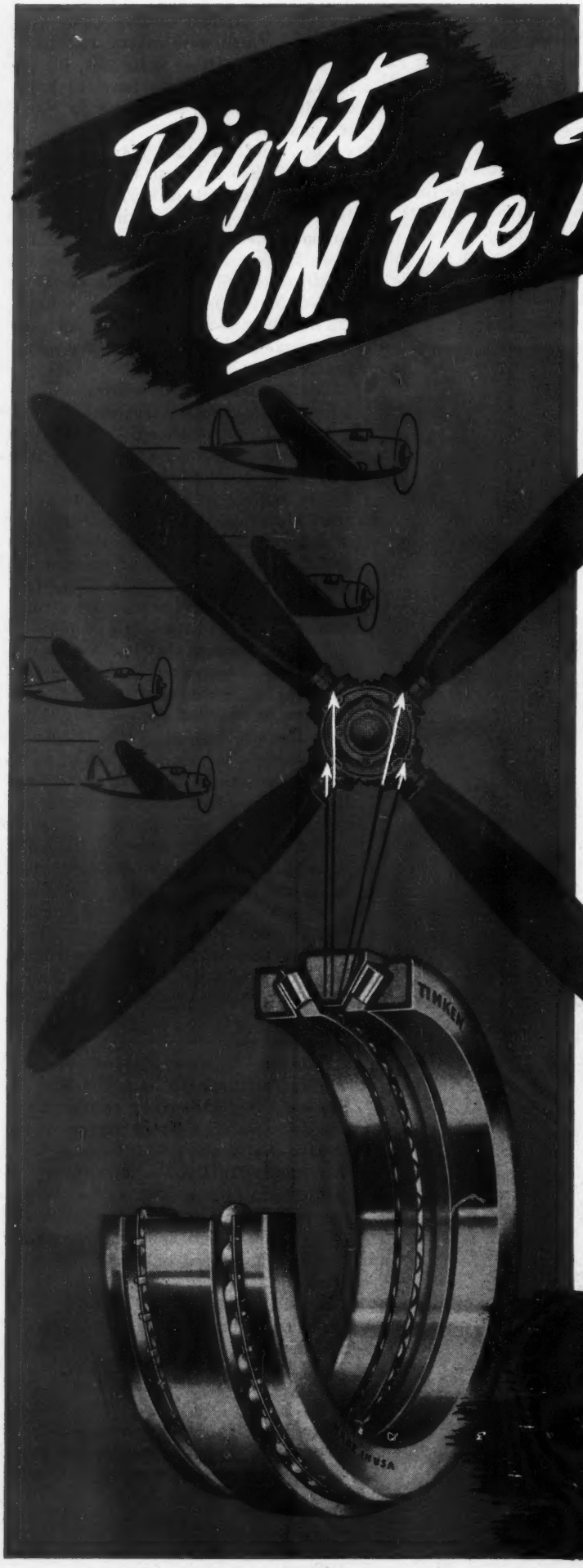
Grenville Bridgeman, vice-president of Metals Reserve Corp.; James V. Forestal, Undersecretary of the Navy and a former Wall Street banker; Judge Robert Patterson, Undersecretary of War; and Will Clayton, director of the RFC and former cotton merchant—they are all in the picture.

There are others, too, who from time to time have been called to Baruch's office (no longer the park bench). These men include Robert E. McConnell, well-to-do engineer; George L. Harrison, president of the New York Life Insur-

(*Turn to page* 333)

Bernard Baruch—His appointment to head postwar reconversion program is considered first break aviation industry has had in move for orderly termination of contracts. Author Hoadley warns, however, that industry itself must take active part to assure complete success of the program. (*Harris & Ewing photo.*)

Right ON the Button



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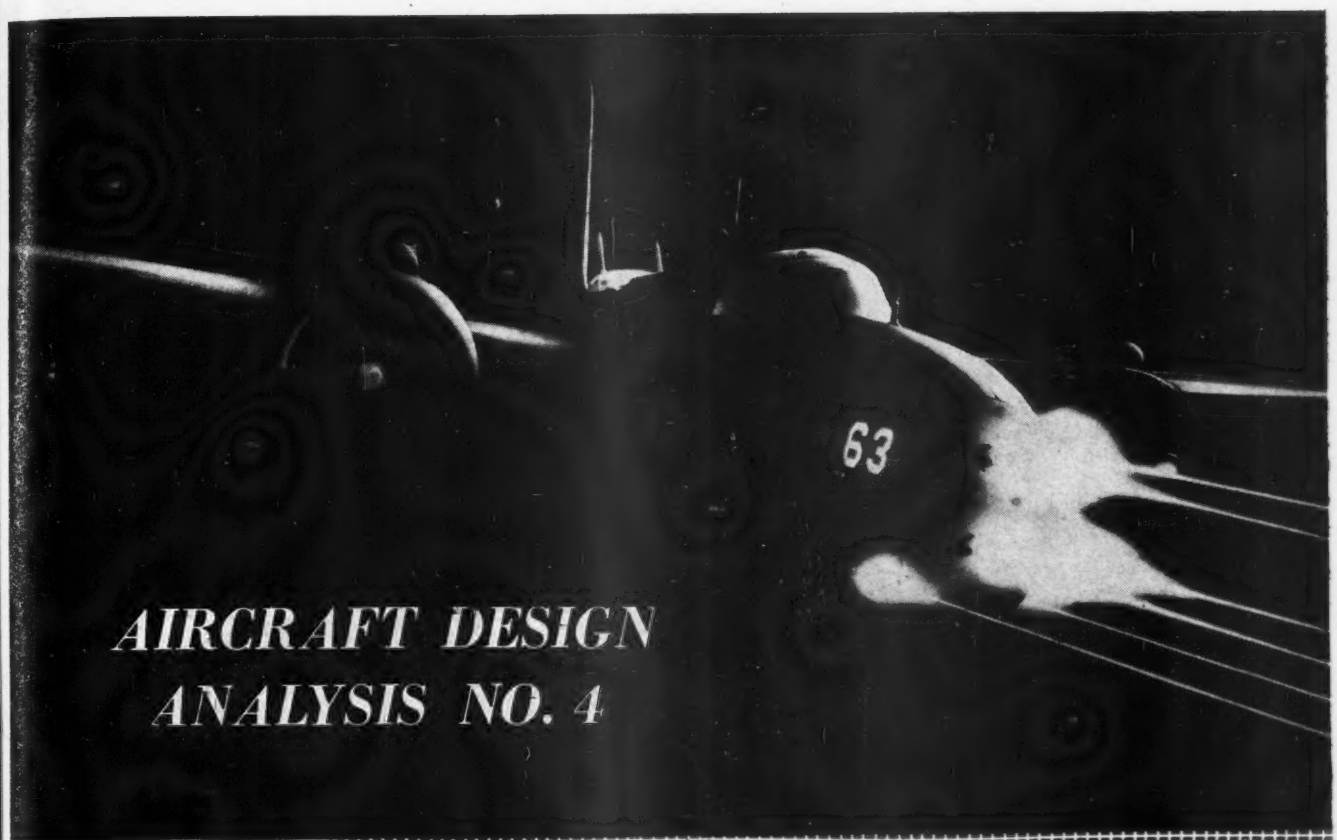


AIRCRAFT DESIGN ANALYSIS NO. 4

A-20 "Havoc"

By T. R. SMITH

Project Engineer, Santa Monica Div., Douglas Aircraft Co.

Known to the AAF as the *Havoc* and to the RAF as the *Boston*, this fighter-bomber can be used on a dozen different kinds of missions with remarkable effectiveness.

THE GREAT VERSATILITY of the Douglas attack bomber was designed into it by a scheme of interchange which bids fair to have considerable effect upon future aircraft engineering technique. The interchangeable noses of the A-20 —which convert it from a medium level bomber to a heavily gunned ground strafer, from photographic ship to night fighter, or from a torpedo plane to a day fighter—constitute an original idea in military plane design. And it's an idea offering a basic step toward achievement of the "impossible"—creating of the "all-purpose" combat airplane.

Regularly assigned by both British and American Air Forces to many types of missions, the A-20 has piled up a record of versatility unsurpassed by any other airplane. Its routine assignments, all requiring variations in equipment, include medium altitude, short and long range, horizontal, skip, and low level bombing, low level attack, day and night fighting, torpedo launching, smoke screen and chemical warfare operations, reconnaisance, and photographic missions.

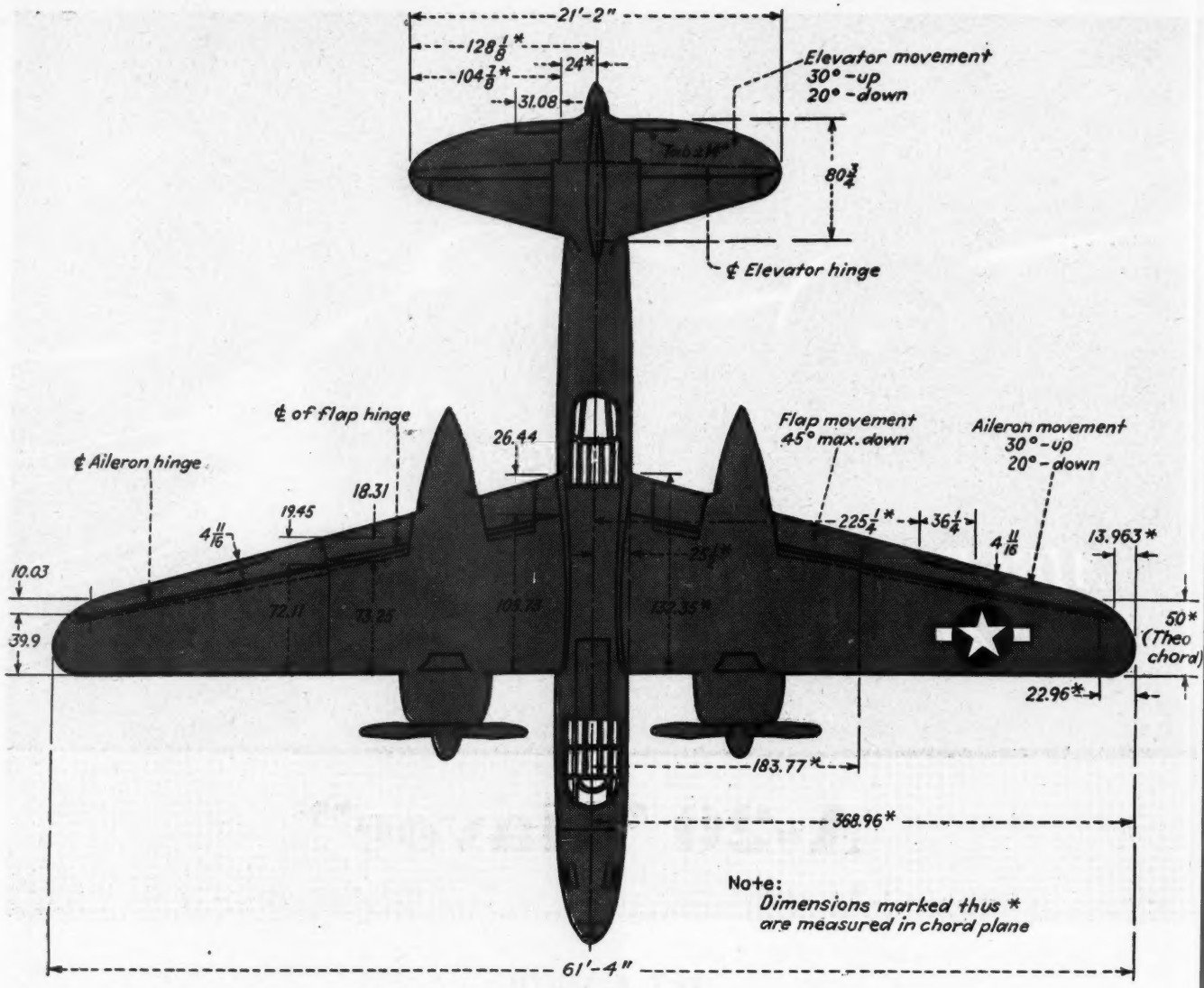
As stated, this versatility is not the result of accidental, emergency, or makeshift conversion. Instead, it stems from a specific decision to design a combat plane that would perform the greatest variety of missions without deviating from the basic model.

Paralleling the problem of design was that of production. Obviously, any airplane intended for a variety of uses, would if successful, be required in great numbers, so it must be designed for large-scale manufacture, and the design must be broken down in such manner that volume could be maintained despite the changes all things must undergo in time of war.

Outstanding among many production-design features of the A-20 is the "half shell" or longitudinal half-section method of main fuselage section assembly. This feature allows the concentration of more workers per assembly.

For attack, the A-20 had to have high speed, maneuverability, and armament to destroy ground objectives. The original design still is adequate to meet changing specifications for more and heavier equipment. As a medium-bomber, the design had to provide fuel capacity and a bomb bay, plus the stability with the bay open, to permit precision bombing.

For attacks upon naval targets, it had to have stability with the bomb bay doors removed and with a 2,000 lb. torpedo suspended half in and half out of the opening. For smoke screen laying and chemical warfare missions, the wing had to accommodate chemical tank racks and control mechanisms, with but slight changes, easily and quickly made, often in the field.



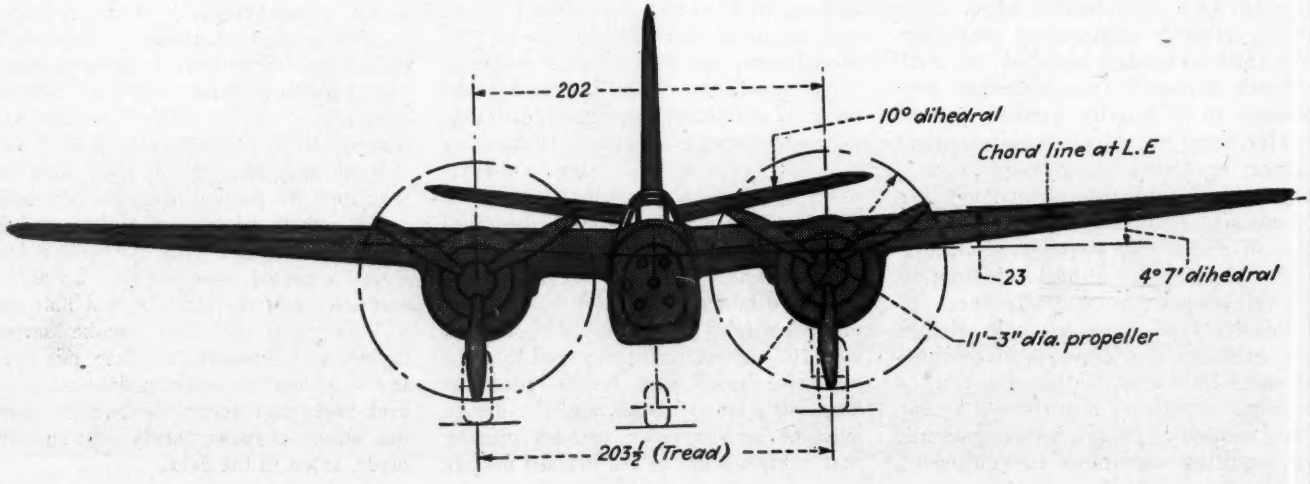
As a night fighter or "intruder," the interchangeable nose feature has provided a means of installing detection equipment, including a powerful searchlight with which RAF *Bostons* point out and momentarily blind the crews of enemy planes in order to get in the first shot. The rugged and roomy fuselage made possible additional armament, including a belly tub with machine guns or cannon, also extra fuel tanks for long range operations.

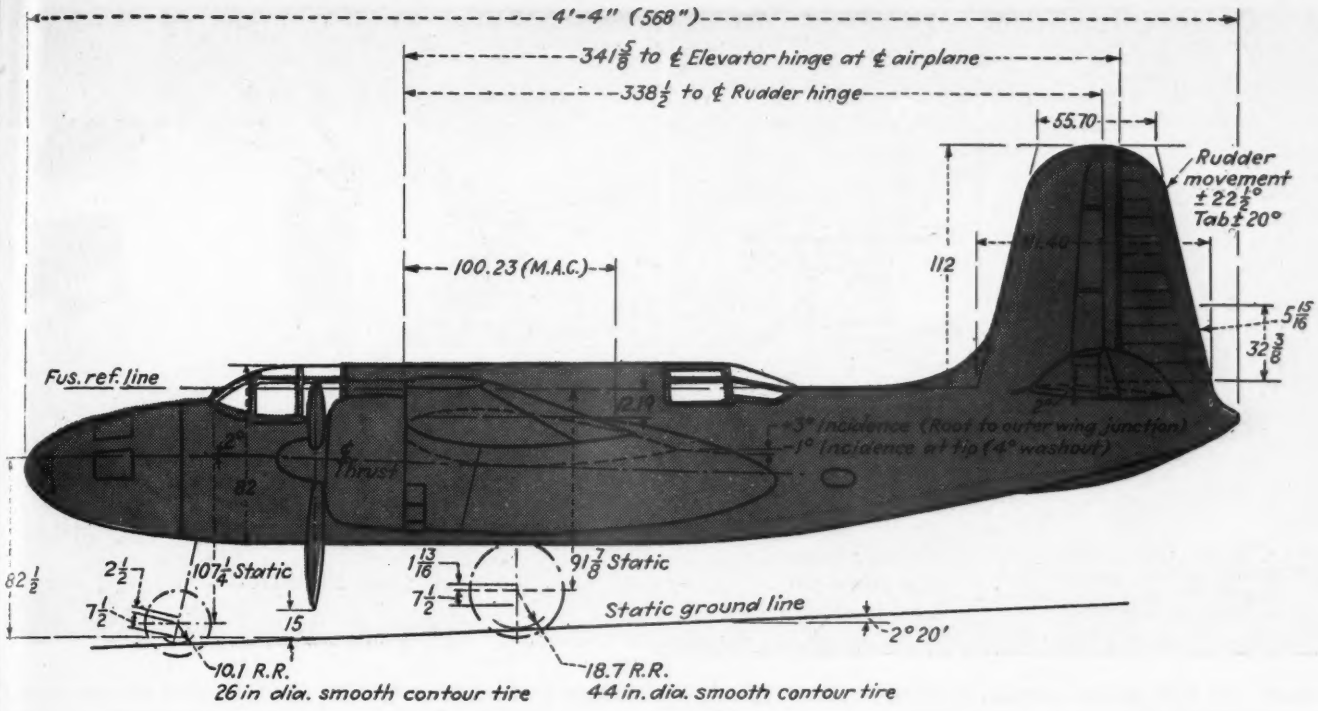
The strength designed and built into the outer wings permits the installation of wing racks to carry additional bombs. Further, the unusually large bomb bay provides space for additional racks for large numbers of small fragmentation bombs for attacks against personnel.

Landing Gear Dimensions

Tread	203½ in.
Wheel base	165 in.
Main wheel & tire size	44 in.
Nose wheel & tire size	26 in.

Carrying a crew of three and equipped with an attack nose in which six .50 cal. machine guns are mounted, with





WEIGHTS

Fuselage

Total weight, 1,512 lb. Includes: pilot's enclosure, 38.6 lb.; bomb bay enclosure, 22.6 lb.; radio compartment enclosure, 8.72 lb.; nose wheel doors, 14.4 lb.; bomb bay doors, 92.61 lb.; and gunners' access doors, 15.3 lb.
Ailerons, total weight, 89 lb., including 40.8 lb. of weights.
Elevators, total weight, 88 lb., including 22.4 lb. of weights.
Rudder, total weight, 83 lb., including 26.6 lb. weights.
Fuel system, tanks, 810 lb.; piping and equipment, 468 lb.; total, 1,278 lb.
Oil system, tanks, 131 lb.; piping and equipment, 213 lb.; total, 344 lb.

Useful Loads

Fuel, 3,300 lb., 540 gal.
Oil, 300 lb., 40 gal.
Fixed armament, (with 2,100 rounds ammunition weighing 654 lb.), total weight, 1,099 lb.
Flexible armament, (with 1,200 rounds ammunition weighing 373 lb.), total weight, 590 lb.

Unit Weights

Fuel system, empty, per gal. capacity, 2.3 lb.
Oil system, empty, per gal. capacity, 8.5 lb.
Wing group, 464.8 sq. ft., 5 lb. per sq. ft.
Tail group, 184.1 sq. ft., 2.2 lb. per sq. ft.

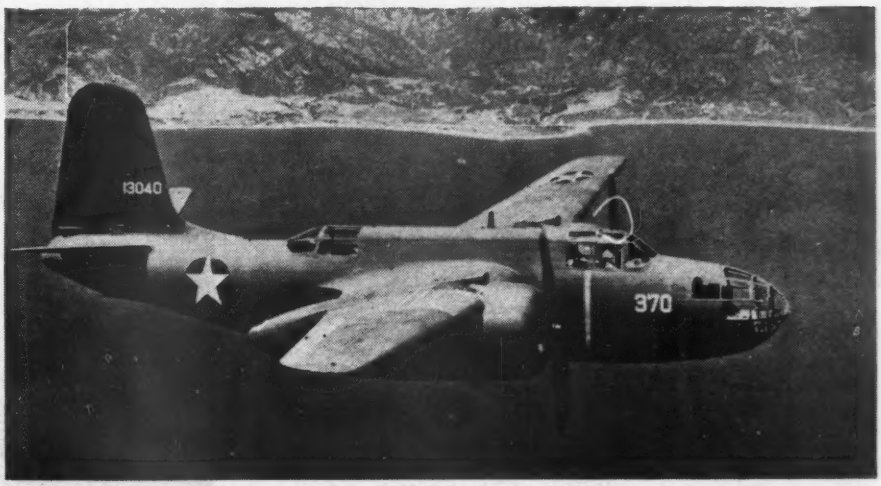
Balance Factors

Attack Condition, gross weight
C.G. location, wheels up, aft L.E.M.A.C. 30.7% M.A.C.
C.G. location, wheels up, below L.E.M.A.C. 15.6% M.A.C.
C.G. location, wheels down, aft L.E.-M.A.C. 29.4% M.A.C.
C.G. location, wheels down, below L.E.-M.A.C. 17.3% M.A.C.
Flying balance range of A-20, between 16% and 33% M.A.C. (wheels down or up)

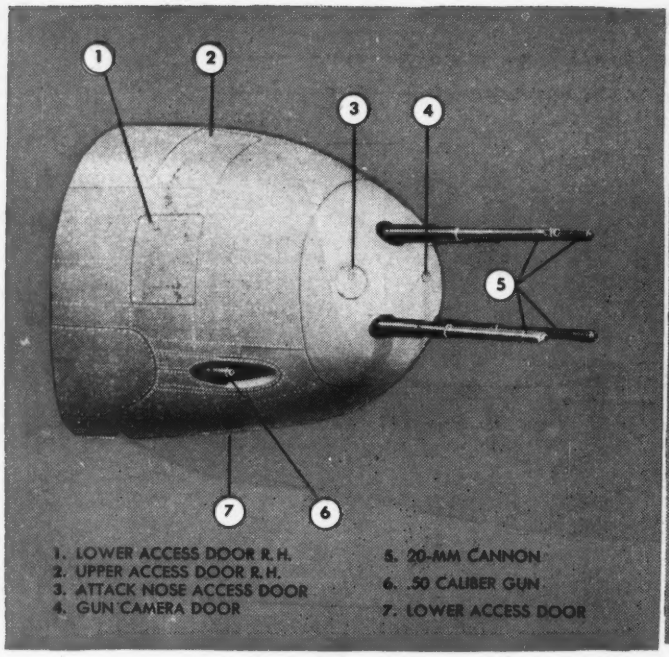
Limit Maneuver Load Factors

At Design gross weight (19,750 lbs.)
Positive maneuver load factor.... 4.0
Negative maneuver load factor... —2.0
Limit Gust Load factor
At design gross weight, flaps up, positive 4.0
At Design gross weight, flaps down, positive 2.27
Limit Landing factor, ground landings
At Design gross weight (19,750 lbs.) 3.33
Limit Diving Speed
120% of max. level flight speed at design gross weight.
Load factor ultimate..... 9Gs.

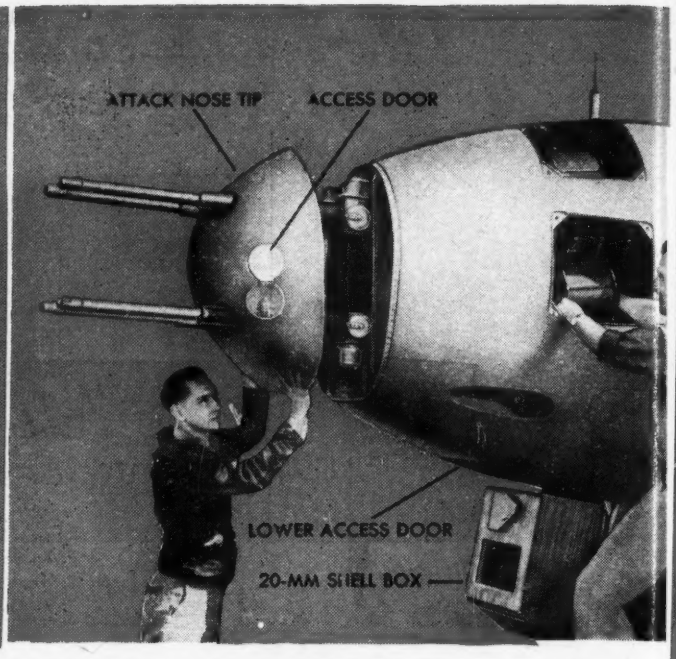
Equipped with four 20-mm. cannon in the nose, also three .30's and three .50's, this special version of A-20 is a formidable attack plane. AAF standard version has six .50's in nose and no cannon.



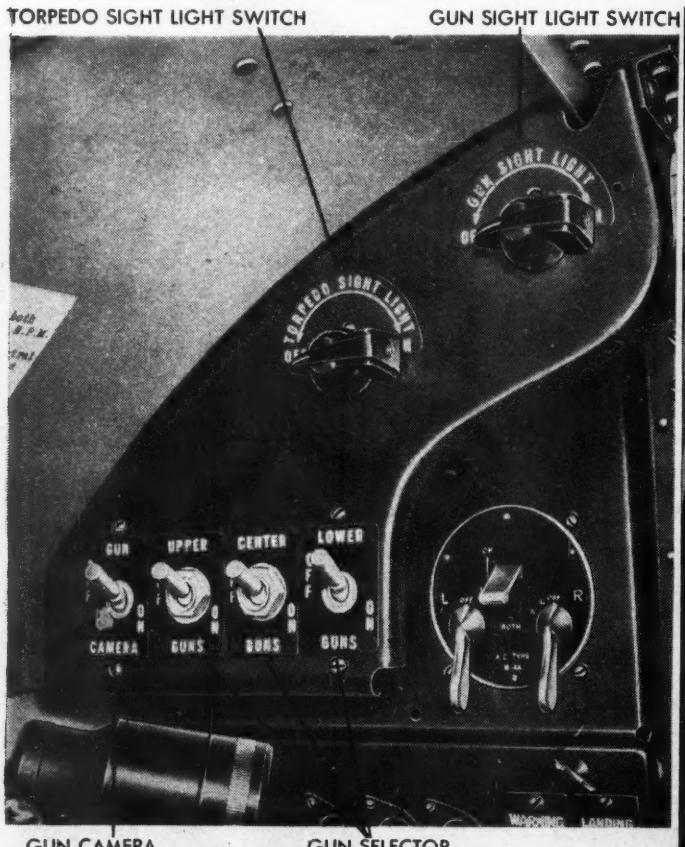
When the attack nose is replaced by a bombardier's compartment the A-20 becomes one of our most dangerous medium bombers.



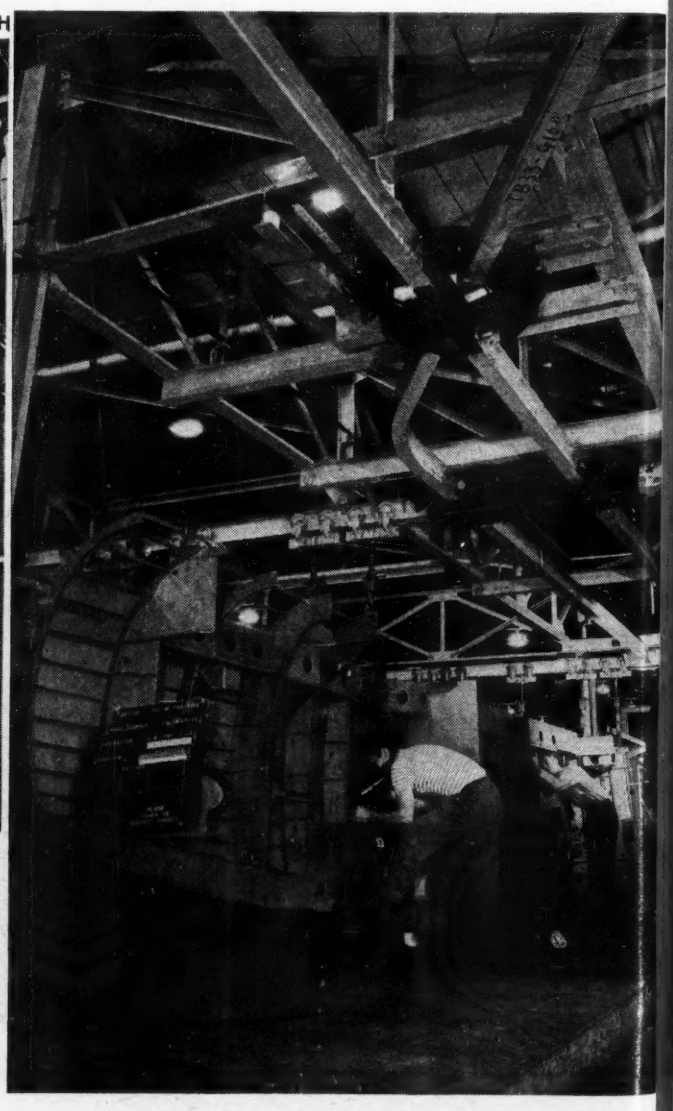
Attack nose with 20 mm. cannon. In center is camera opening. Lower sides carry .50-cal. guns. Circular door on nose is for access to guns. Other doors are square openings at top, sides and bottom.



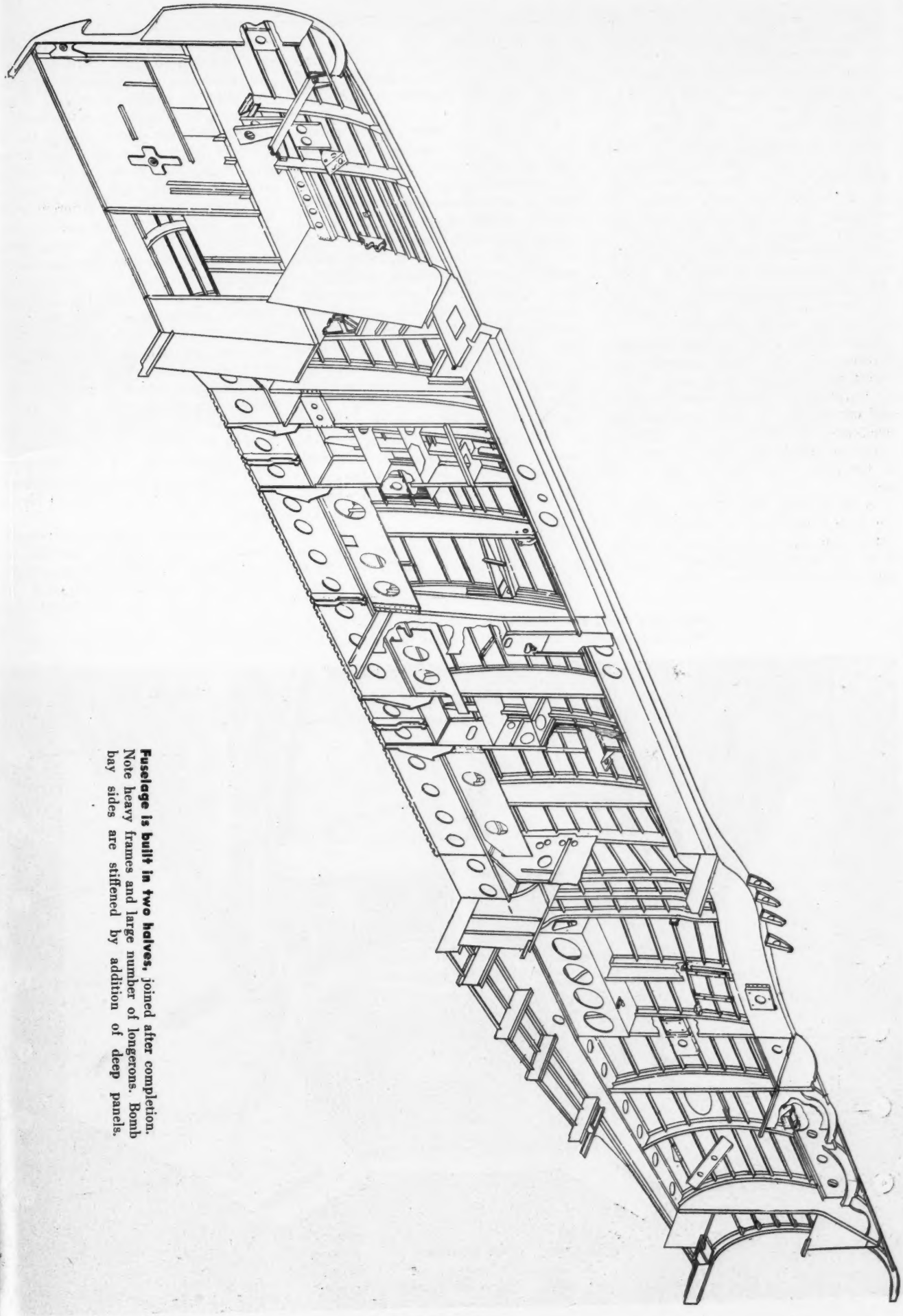
Removing attack nose tip. This part is loosened through circular access door. Shell box (bottom) for cannon ammunition is inserted through lower door.



Gun and gun-camera selector switches in row at lower left. Torpedo sight light switch at center and gun sight light switch at top right.



Half shell construction of fuselage is chief reason for speed in manufacture.



Fuselage is built in two halves, joined after completion. Note heavy frames and large number of longerons. Bomb bay sides are stiffened by addition of deep panels.

886008

upper rear and lower gun positions, and having close to single-seat fighter speed and maneuverability, the A-20 becomes a hard hitting, pugnacious day-fighter.

Such an airplane, of course, could not be designed in entirety back in 1938, when the first model was built. But from that original 11,850 lb. twin-engine, 280 mph. ship, armed with four fixed, one upper, and one lower gun, all of .30 cal. has come, through two succeeding series, the current A-20. The 7B was followed by the DB7 which, in turn, gave way to the DB-7A for export and the A-20A for the USAAF. Principal differences between the DB-7 and DB-7A were larger and more powerful engines and larger tail surfaces.

The A-20A, which was the immediate forerunner of the present versatile A-20 series, was designed for a gross weight of 19,750 lb., carried a crew of three, and was armed with four forward-firing fixed machine guns, an upper flexible twin-gun installation, and a single gun in the lower rear position, all of .30 cal.

In its present series (often modified) the A-20 is an all-metal midwing monoplane with over-all wing span of 61 ft. 4 in. Over-all length is 47 ft. 4 in. with the bombardier nose, and 48 ft. with the attack nose. And over-all height at rest is 18 ft. 1 in.

Two 14-cyl. 1,600 hp. Wright GR2600 engines drive Hamilton Standard Hydromatic propellers of 11 ft. 3 in. dia.

The A-20 has seven major components: Nose, main fuselage, empennage, right and left inner wings, and right and left outer wing panels. The fuselage is a semi-monocoque all-metal structure comprised of extruded 24S aluminum alloy longitudinals, spaced 4 to 8 in. apart, and formed of 24ST Alclad sheet, channel-type frames, spaced 12 to 24 in. apart. At highly stressed points, the frames are built up of extruded sections and sheet aluminum alloy gussets. The Alclad 24ST sheet covering is attached to the frames with flush rivets and is stiffened by the longitudinals. Lap joints are used, with vertical laps either joggled to make a smooth contour or, in the case of heavy sheets, beveled along the outer edge. The semi-monocoque design was chosen because it combines the required strength with the least weight and is simpler to manufacture.

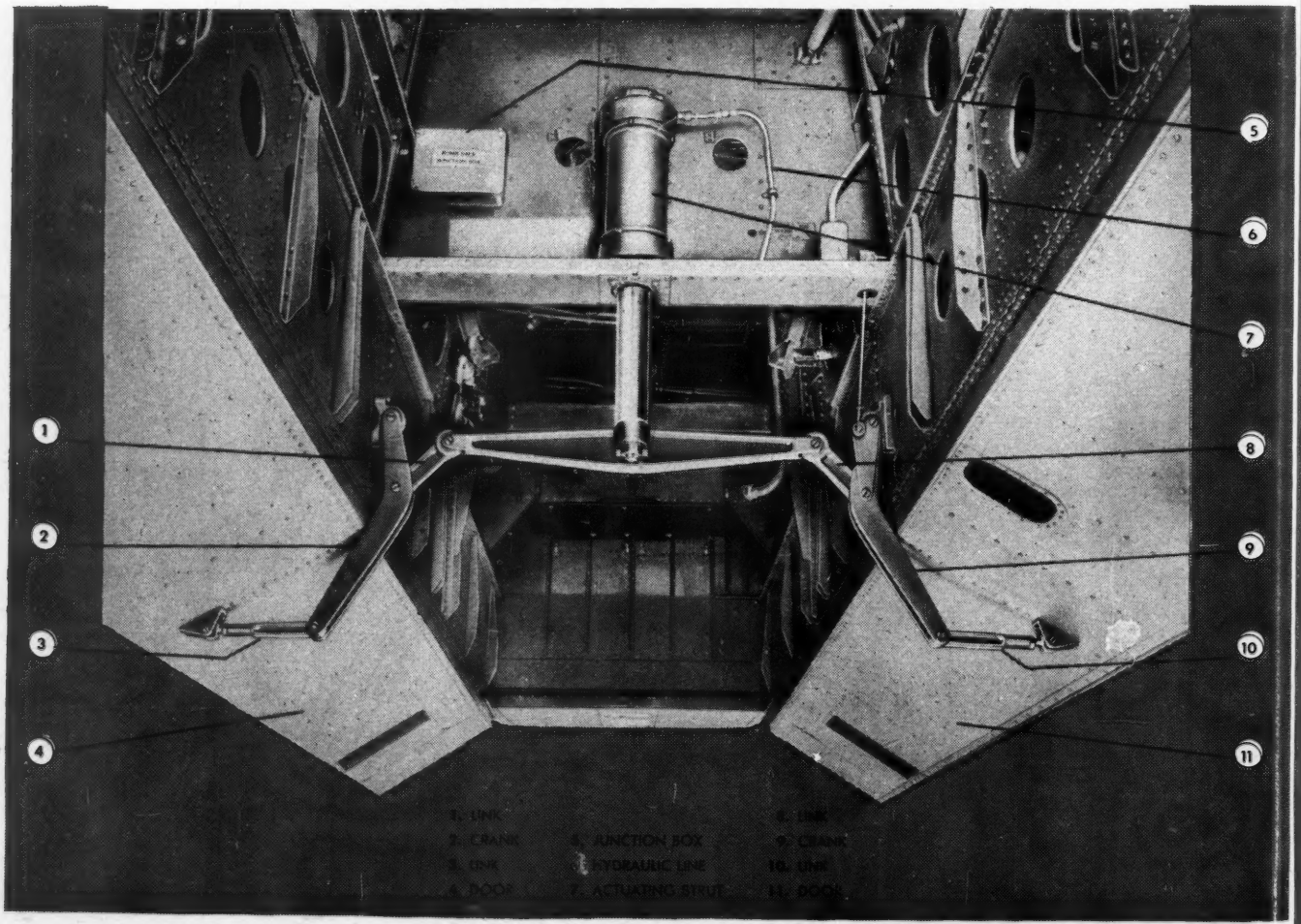
Five major sections comprise the fuselage: Attack or bombardier nose, pilot's cockpit, bomb bay, gunner's compartment, and tail compartment.

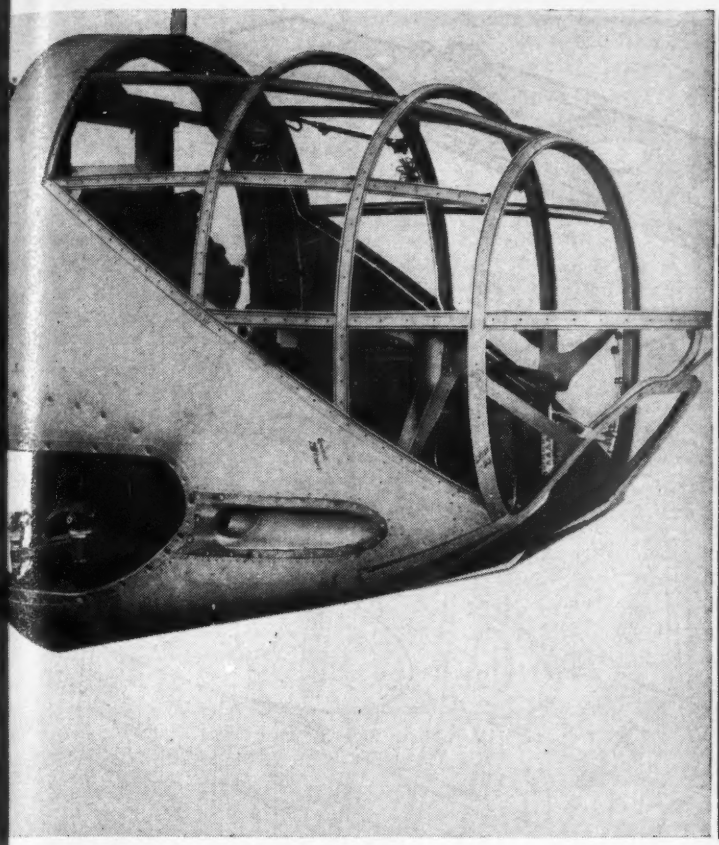
Nose sections, keying much of the A-20's adaptability to varied types of missions, are interchangeable, one with the other or from ship to ship. Changing them is merely a "wrench and screw driver job" that can be done in the field by two men in six hours or less. In general appearance, there are two kinds of noses, bombardier and attack, but actually there are several different attack types, each of which mounts a different combination of guns or night fighting detection devices, with the necessary variations in structure.

Only six bolts secure the bombardier nose to the fuselage, while ten are required for the attack noses. Of these ten, eight are spaced around the perimeter of the attach ring or station and two are located inside of the outer line of bolts. Trunnion fittings at the forward end of the nose and swing links toward the after end of the structure form supports for the four center fixed guns. The two side guns are supported directly on castings attached to the nose beams.

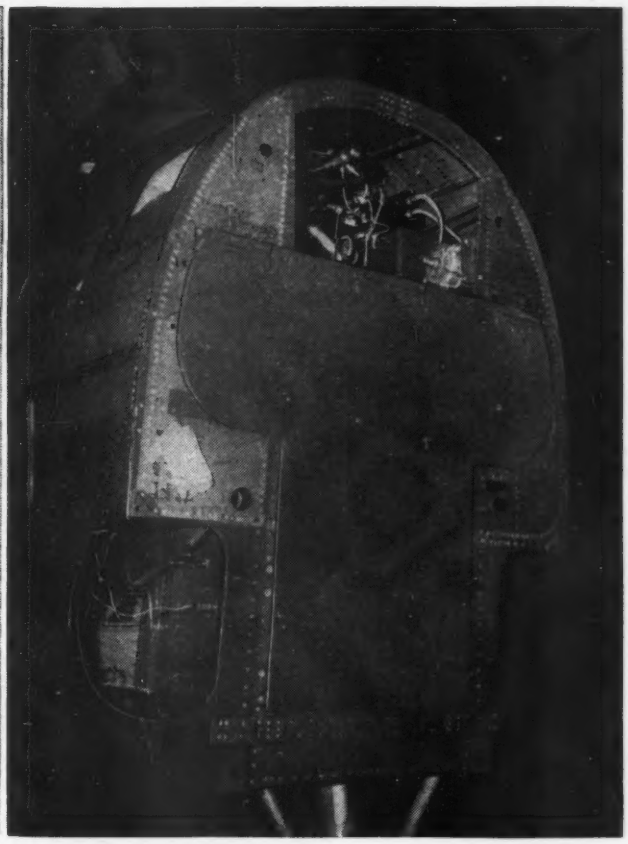
In dimensions, all types of noses are identical at the point of junction with the fuselage, but the attack nose is 8 in. longer than the bombardier version. The

Bomb bay doors and mechanism. Hydraulic cylinder in center opens and closes doors through toggle linkage. Indicator rod runs upward from right hand arm.



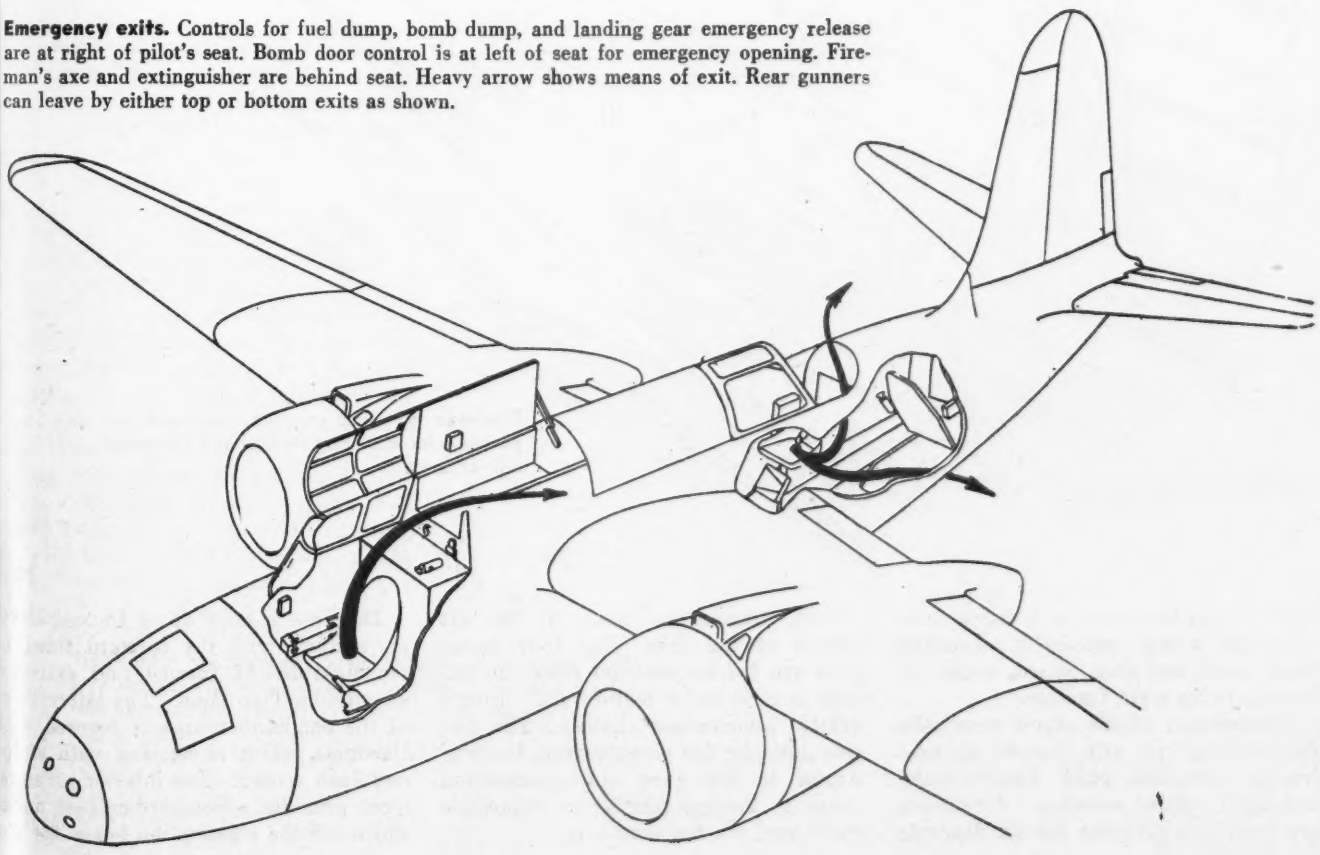


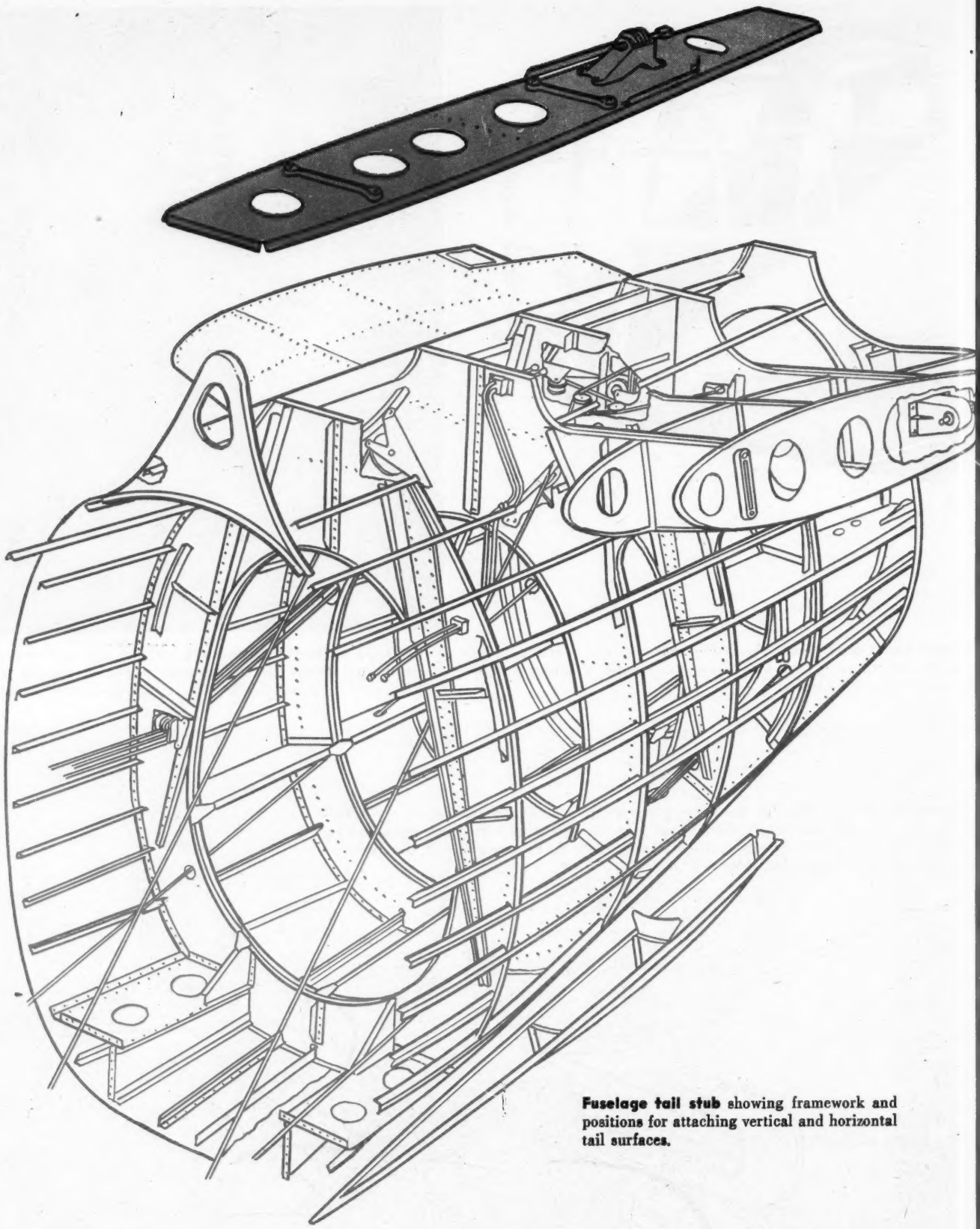
Bombardment nose frame before Plexiglas covering is attached. Note tube for .50-cal. gun at side with access door behind it. Bottom exit door is provided for bombardier.



Bulkhead is heavily armored to protect pilot and instruments from frontal attack. Top section of armor has not yet been placed. Changeable noses join fuselage at this station.

Emergency exits. Controls for fuel dump, bomb dump, and landing gear emergency release are at right of pilot's seat. Bomb door control is at left of seat for emergency opening. Fireman's axe and extinguisher are behind seat. Heavy arrow shows means of exit. Rear gunners can leave by either top or bottom exits as shown.





Fuselage tail stub showing framework and positions for attaching vertical and horizontal tail surfaces.

latter is manufactured as a single unit, while the attack version is assembled "half shell" and then joined, much the same as is the main fuselage.

Construction of the attack nose calls for building up with formed channel frames, extruded 24ST longitudinals, and 24ST Alclad covering. Provisions are made for carrying the six separate .50-cal. ammunition boxes at the aft section of the nose. The four center guns are fed ammunition from the box over electric boost motors and through flexible ammunition chuting. The two side guns are fed directly from the box. Access to the guns and ammunition boxes is through hinged or removable doors and via the nose cap.

The nose is built up of formed channel sections with the forward third of the structure of formed and extruded magnesium T sections. The latter third of the bombardier nose is covered with Plexiglas, which is retained with strips and flush screws. The interior arrangement provides a bombardier seat under which are the ammunition boxes for the

Vertical tail surfaces. Detail at lower left shows method of attaching fin to fuselage stub. Tail cone bolts to rear face. Rudder and tab at right, with enlarged detail of hinge below.

Horizontal Tail Surfaces

Area (Including fuselage area)..100 sq. ft.
Area (Less fuselage area).....81.7 sq. ft.
Span .....21 ft. 1½ inches
Maximum Chord .....80 inches
Distance from design gross wt. C.G. to ¼ maximum chord point.....24½ ft. 295% M.A.C.

Horizontal Stabilizer

Area (including fuselage and elevator extensions .....60.8 sq. ft.
Area (less fuselage).....42.5 sq. ft.
Normal setting +2 degrees (relative to long axis)
Angular movement: .....none

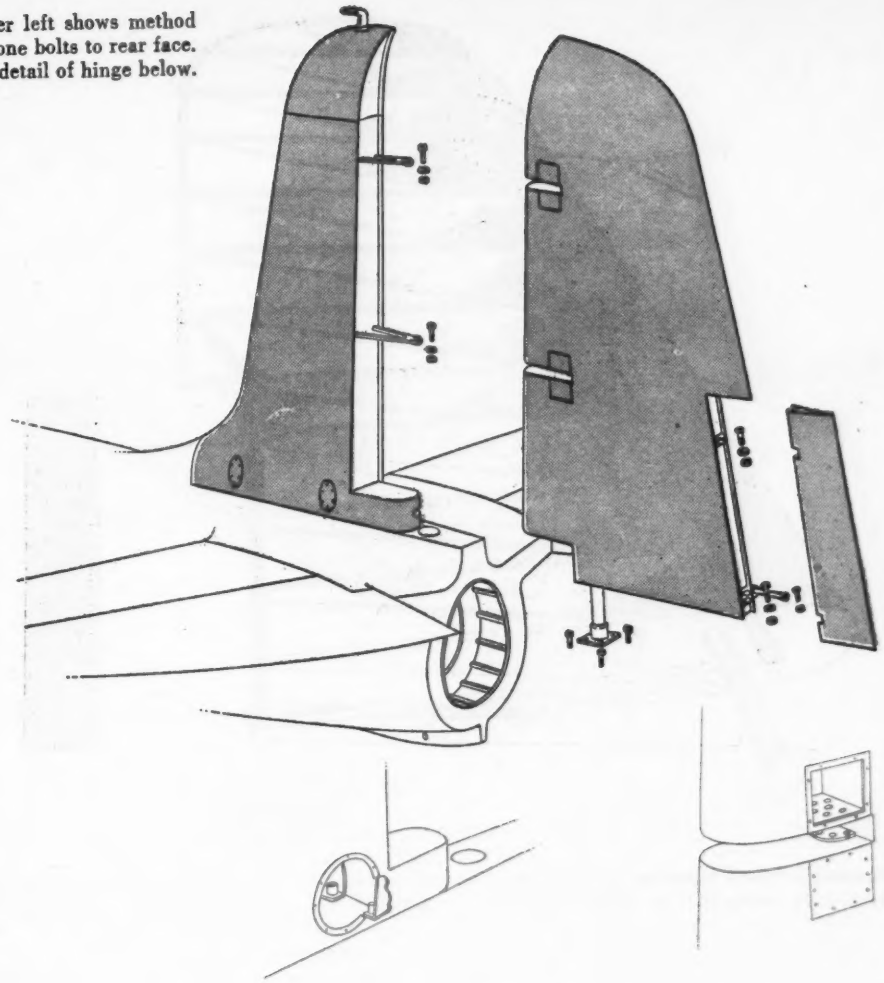
Elevators

Area each. .....39.2 sq. ft.
Angular movement. Up 30 deg., down 20 deg.

Vertical Tail Surfaces

Stabilizer
Area, Total, (Less fairing)....24.8 sq. ft.
Normal setting ..... 0 degrees
Angular movement ..... none

Rudder Data
Area ..... 35.1 sq. ft.
Angular movement .....22½ deg. right
22½ deg. left



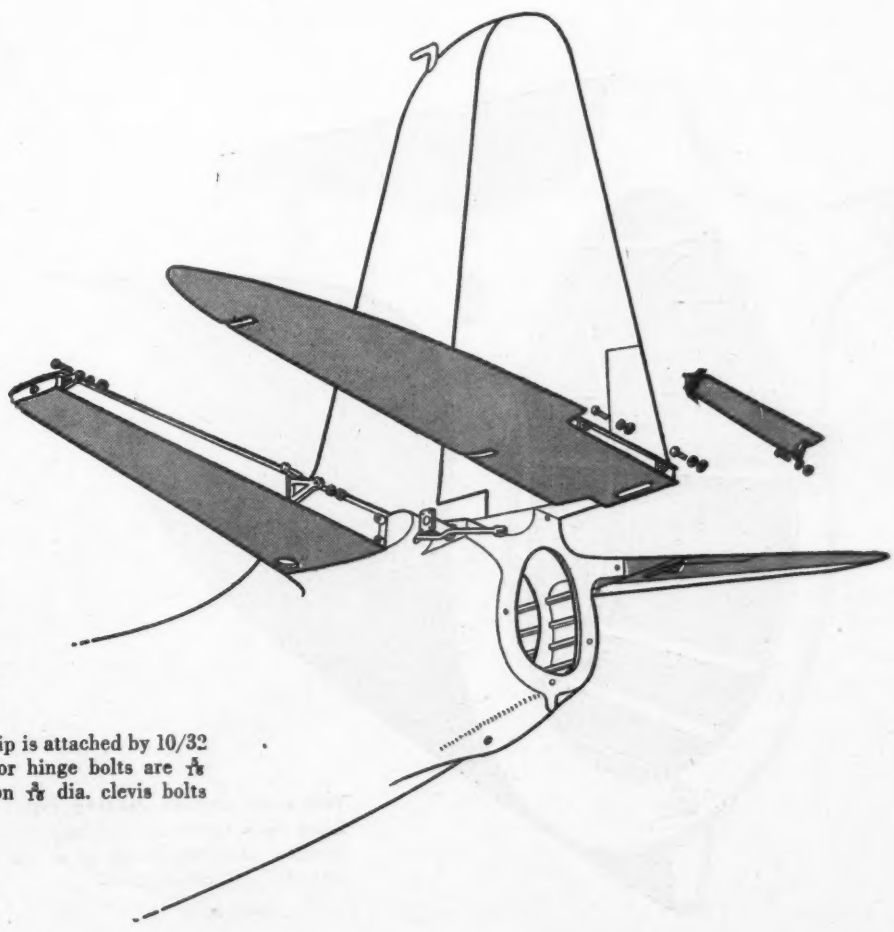
side guns. There is an instrument panel, together with brackets, for various types of bomb sights, also a laminated plate glass panel for sighting.

Although the idea of interchangeable noses was part of the original design, the company does not claim, of course, to have foreseen all of the different nose sections called for by combat experience in this war. Basically, there could be very little change in the structure of the several versions. The chief problem has been to find sufficient space for the steadily increasing size and amount of armament without altering the maximum dimensions of the section.

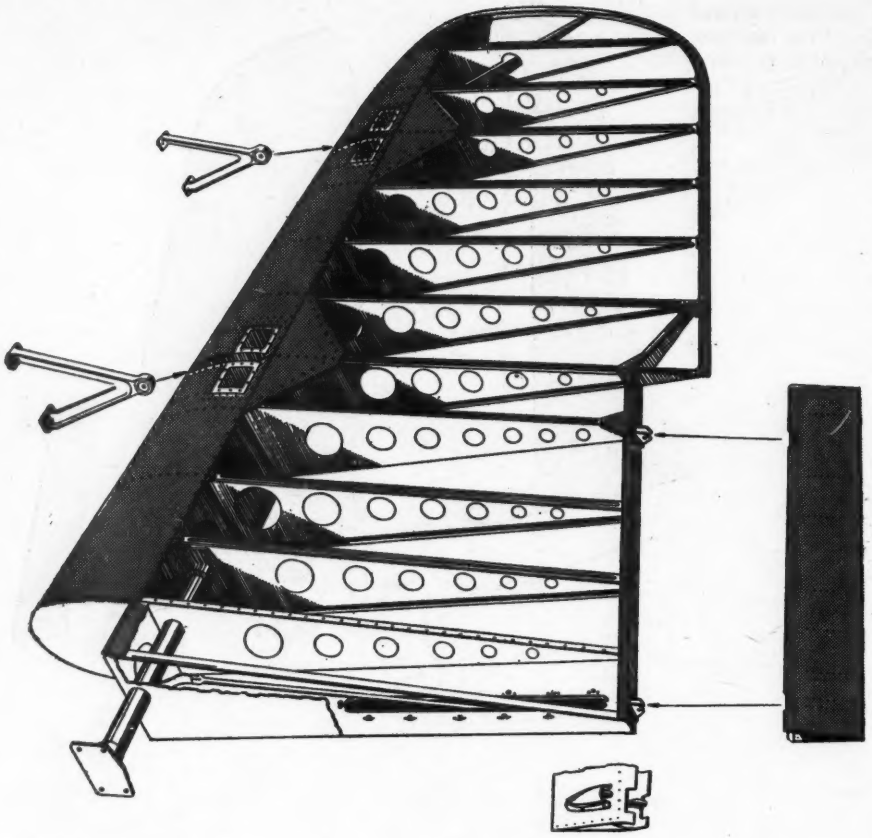
For maximum all around vision, the pilot's compartment is located forward of the wing and engine nacelles. From a normal position in the cockpit, the pilot's vision directly forward over the center line of the fuselage exceeds 8 deg. below the horizontal.

Access is by means of a door in the top of the cockpit enclosure. This door, extending from the windshield to the leading edge of the wing, is hinged at the right side and opens upward. An assist facilitates entry.

The wind screen is laminated plate glass and molded Plexiglas, the center panel being curved laminated plate and the side and top panels of molded Plexiglas. Behind the laminated plate, and



Horizontal tail surfaces. Stabilizer tip is attached by 10/32 screws and Elastic Stop nuts. Elevator hinge bolts are ⅜ dia. Elevator tab (right) is hinged on ⅜ dia. clevis bolts with shear nuts.



Rudder is fabric covered over Alclad frame and leading edge. Tab is operated at bottom by rod in recess shown. Lower recessed Alclad sides are secured by 6/32 rivet nuts.

Wings

Airfoil section, root	NACA 23018
tip	NACA 23010
Wing area, total	464.8 sq. ft.
Span	61 ft. 4 in.
Root chord	138.5 in.
Tip chord (projected)	44.0 in.
Taper ratio	.32
Incidence, Inboard panel	+3 deg.
Outboard, panel, root	+3 deg.
Outboard panel, tip	—1 deg.
Dihedral (L.E.)	4 deg. 7 min.
Sweepback (L.E.)	0 deg.
Max. rib spacing	15.5 in.
Spar location	38% chord
Shear web location	65.9% chord
Aspect ratio	8.07
Mean aerodynamic chord length	100.23
Location relative to L.E. (Root Chord):	
Horizontal	0
Vertical	10.8
Thickness (root chord) of wing	24.93 in.
Thickness (tip chord) of wing	4.4 in.
Wing area (net)	464.8 sq. ft.

Ailerons

Area (total)	42.1 sq. ft.
Angular movement	Up 30 deg., down 20 deg.
Differential motion	1.5:1
Distance from plane of symmetry to centroid of aileron area	260 in.

separately mounted in a hinged frame, is a bullet-proof plate glass that can be swung away from the windscreen for cleaning.

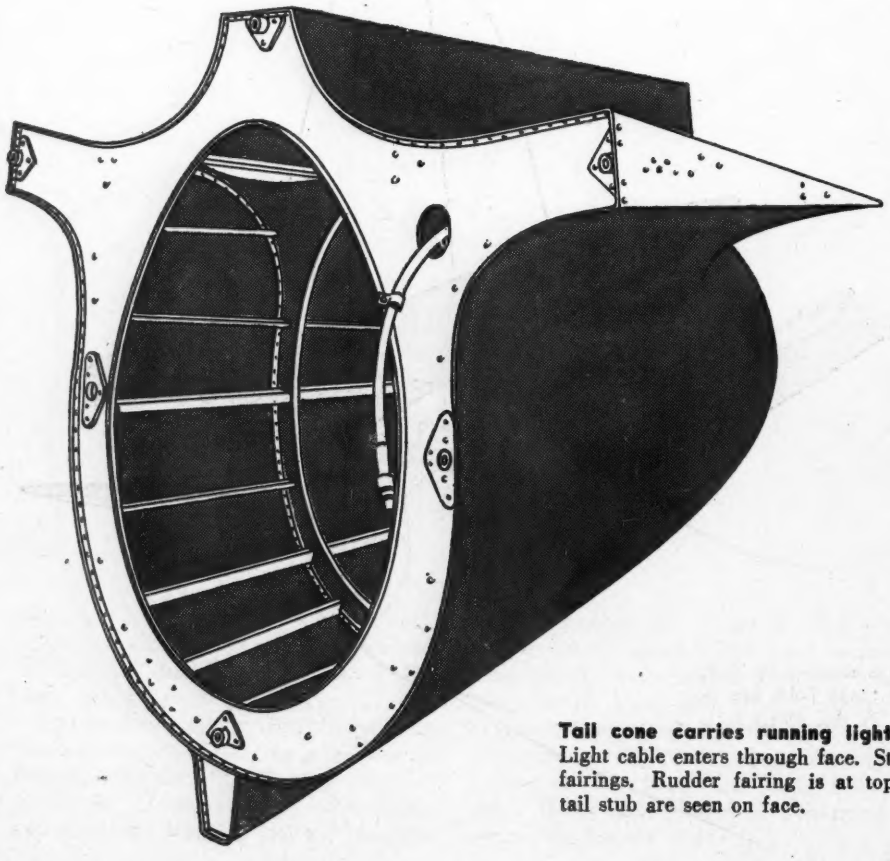
Movable transparent side panels extend from the windscreen to a point at the side of the pilot's head. These panels are mounted in a fore and aft slide to permit opening the sides of the cockpit. The corner panels of the windscreen are in two sections, with the upper section hinged and capable of being folded and fastened inward to permit direct vision when desired.

A standard adjustable pilot's seat is provided and a wheel on a cast magnesium column gives control for the ailerons, while the column operates the elevators. The wheel also incorporates the switches for gun firing and bomb release. Rudder pedals are provided with integral brake control.

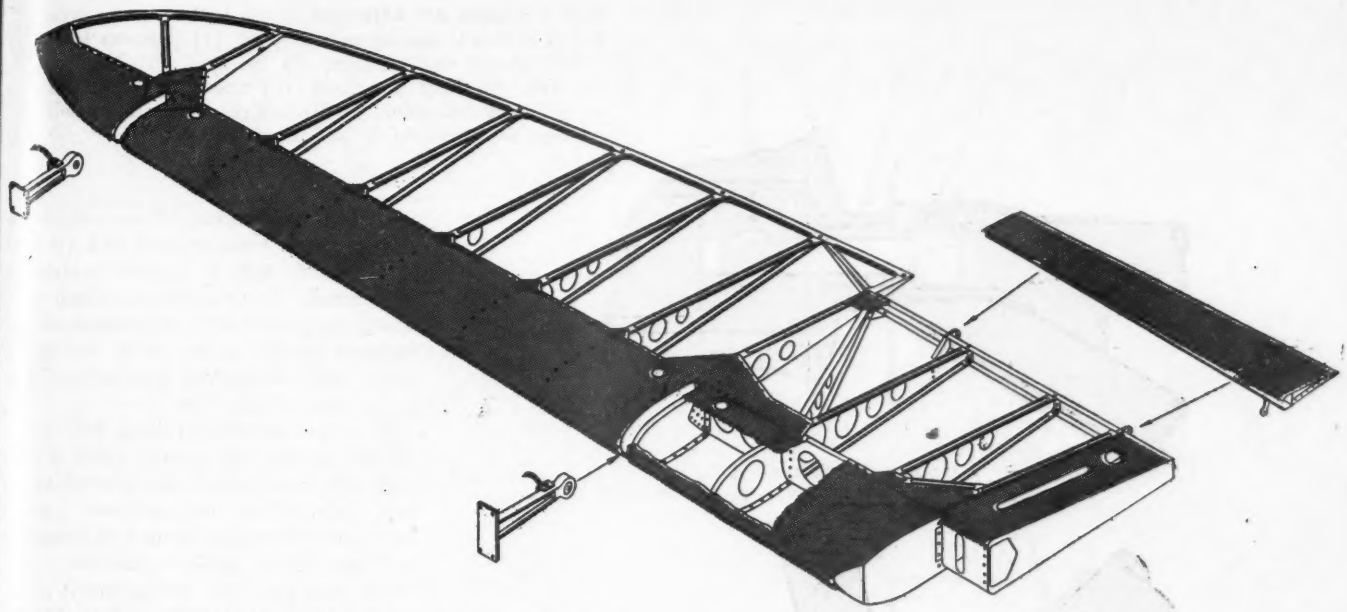
An instrument panel incorporating all of the necessary flight and engine operation instruments is provided. On the right-hand side near the fuselage skin and just above the floor is the electrical panel for the bombing circuits affording all selections of such circuits. On the left side, directly opposite the bomb selection panel, is the panel which carries the balance of the electrical switches for the operation of the airplane. The pilot has all the basic radio controls, and only interphone positions are provided for the balance of the crew.

Insulation of the cockpit is flameproof cloth-covered "Sepack," or "Resistohyde" covered kapok felt, to reduce noise.

From the forward tip of the nose to the bulkhead front end of the bomb bay, the contour of the fuselage represents faired lines. Beginning there and con-

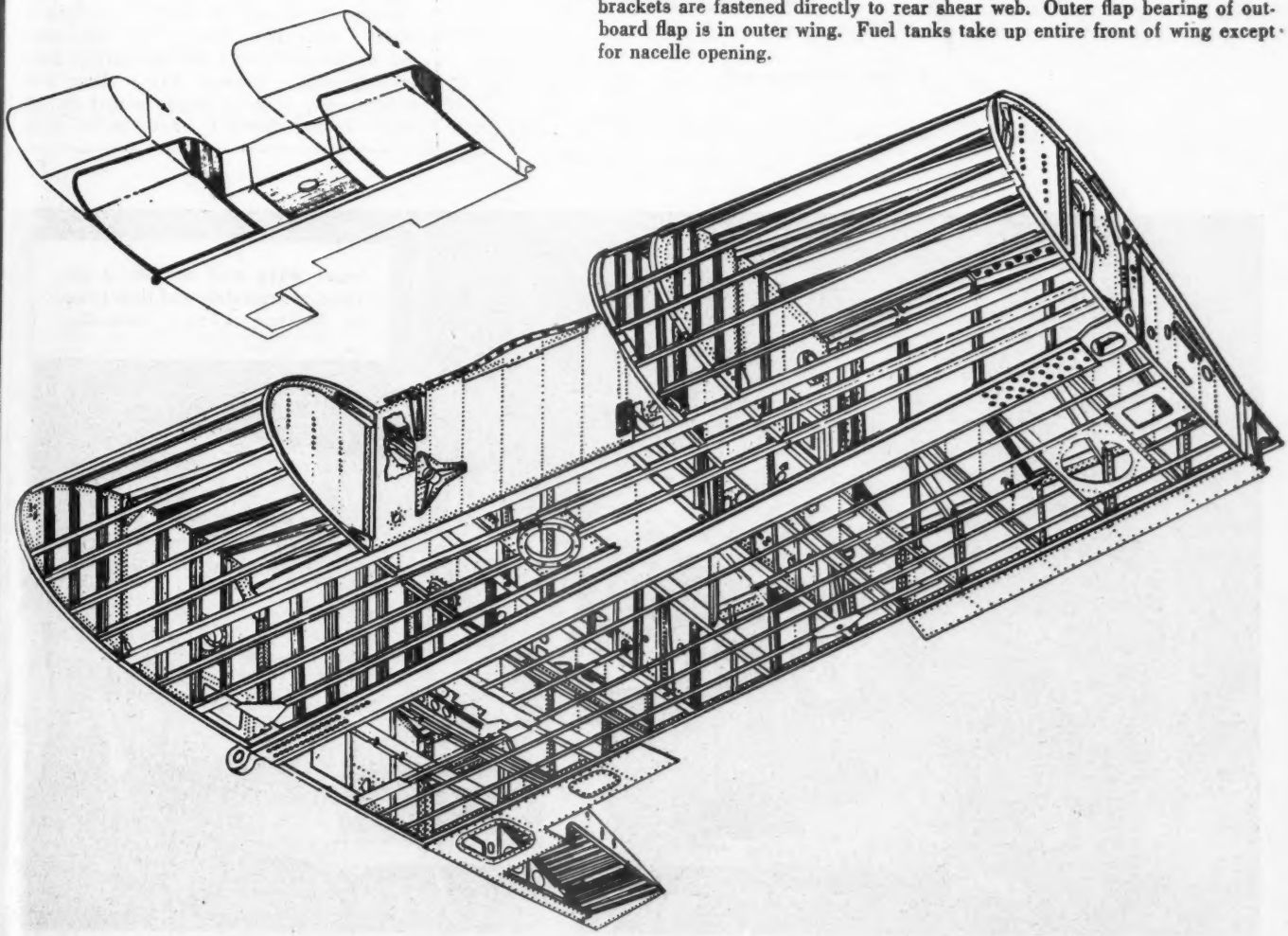


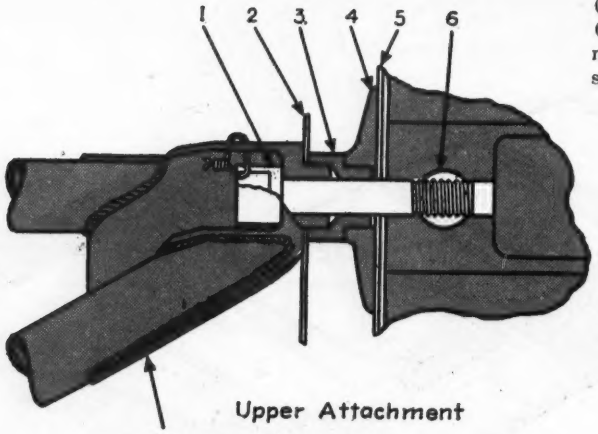
Tail cone carries running lights and formation signal light. Light cable enters through face. Stubs at upper sides are elevator fairings. Rudder fairing is at top. Bolt holes for attaching to tail stub are seen on face.

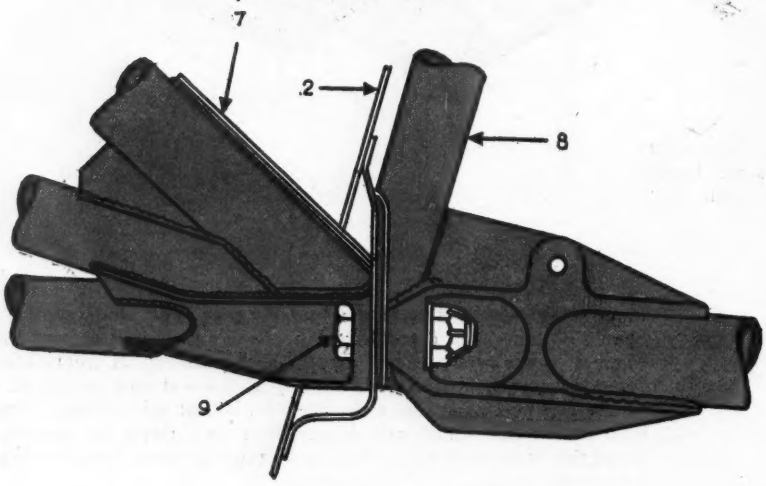


Elevators are similar in construction to rudder. Tab (right) is operated by arm on lower side. Hinge brackets are bonded as shown. Note rigid bracing both by gussets and struts.

Inner wing is built around a single Wagner spar and two shear webs. Spar is 38 percent of chord from L.E. Rear web is 65.9 percent from L.E. Front web is skeleton except across nacelle opening in front of oil tank. Wing is fastened to fuselage by two $\frac{7}{8}$ in. bolts at spar, one $\frac{1}{2}$ in. bolt at front and $\frac{1}{2}$ in. bolt at rear web with $\frac{1}{2}$ in. bolt at rear of wing. Flap hinge brackets are fastened directly to rear shear web. Outer flap bearing of outboard flap is in outer wing. Fuel tanks take up entire front of wing except for nacelle opening.







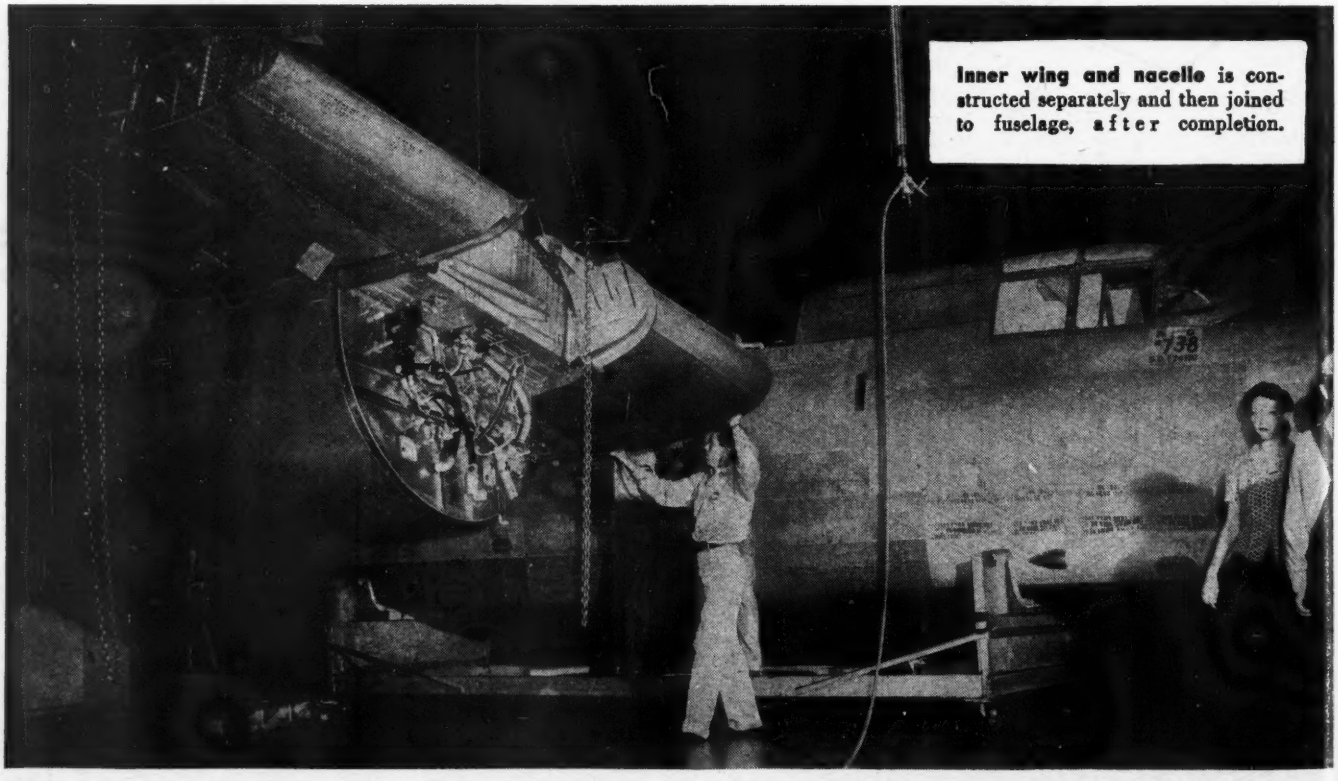
Engine mounts are attached at top to front shear web and at bottom to landing gear support. (1) indicates bolts (two) inboard and outboard, (2) fire wall, (3) bushing, (4) pad, (5) front shear web, (6) trunnion, (7) engine mount, of welded tubing, (8) landing gear support, (9) bolt securing engine mount to landing gear support.

tinuing to the bulkhead front end of the rear gunner's compartment and aft end of the bomb bay, a constant section is maintained. In this section, which represents approximately 60 percent of the fuselage length, is the 14 ft. by 33 in. bomb bay, considered unusually large for a plane of this type.

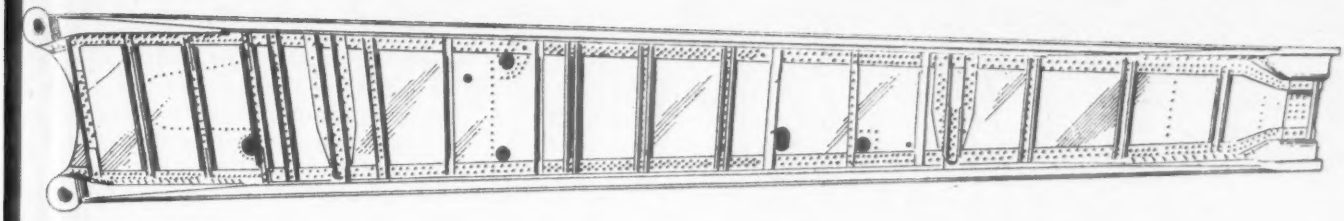
It is this constant section, plus those containing the rear gunner's and pilot's compartments, which are assembled in two longitudinal half-sections, joined only after the major portion of assembly and installation work is finished.

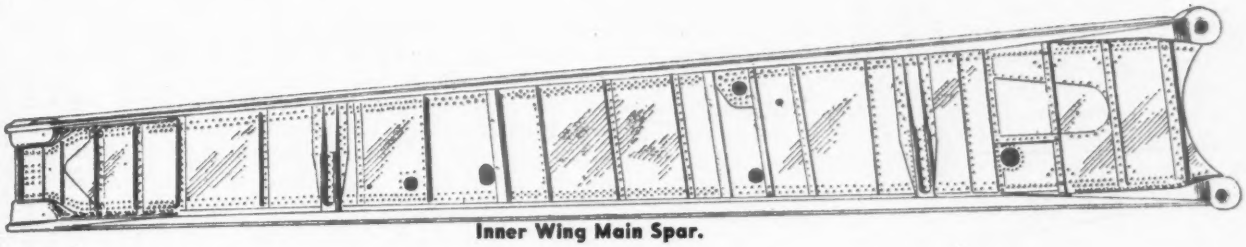
The rear gunner's compartment is located aft of the trailing edge of the wing, immediately behind the aft bomb bay. Entrance is by a door in the bottom of the fuselage. The top section of the gunner's compartment is made up of two Plexiglas parts, one fixed and one movable enclosure which slides forward

Drawings, opposite page, show wing construction detail. Top: Inner wing main spar, situated 38 percent of chord from leading edge. Center: Rear shear web to which flaps are bracketed. It is placed 65.9 percent from leading edge. Bottom: Front shear web which passes between engine mount and oil tank. Engine mount is bolted to top edge.

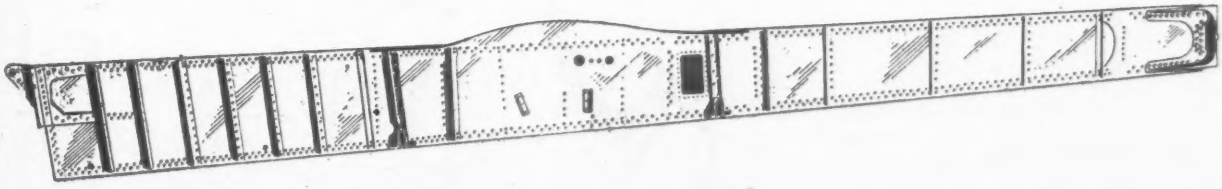


Inner wing and nacelle is constructed separately and then joined to fuselage, after completion.

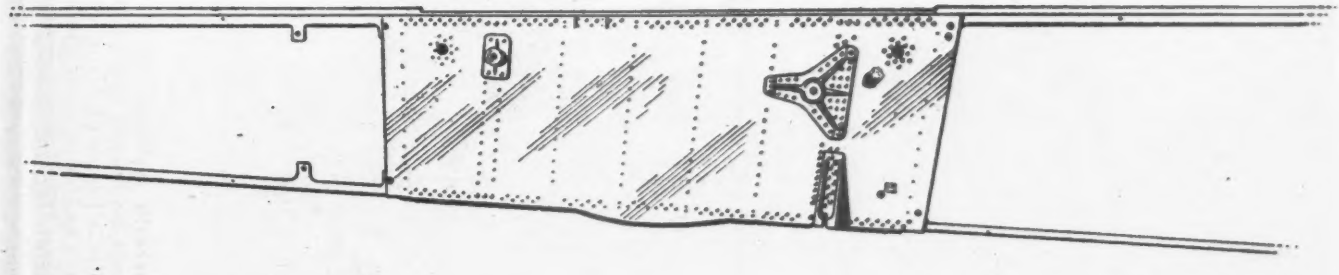


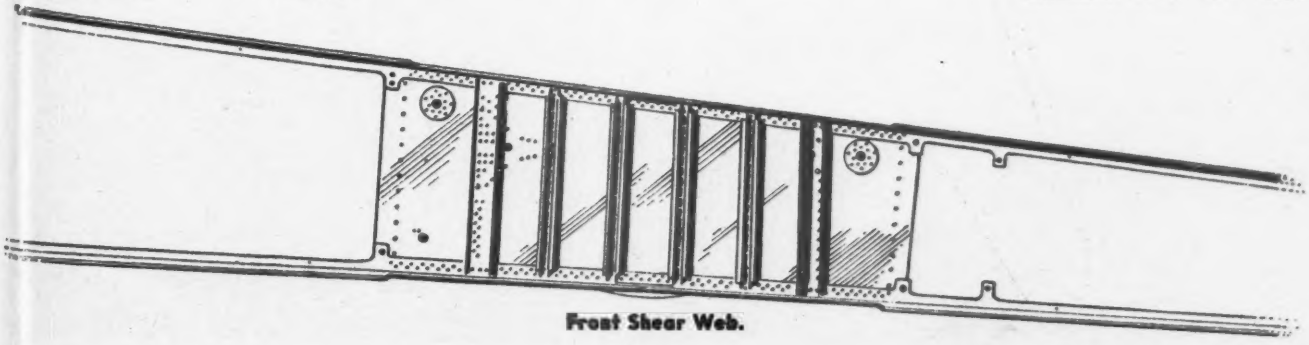


Inner Wing Main Spar.

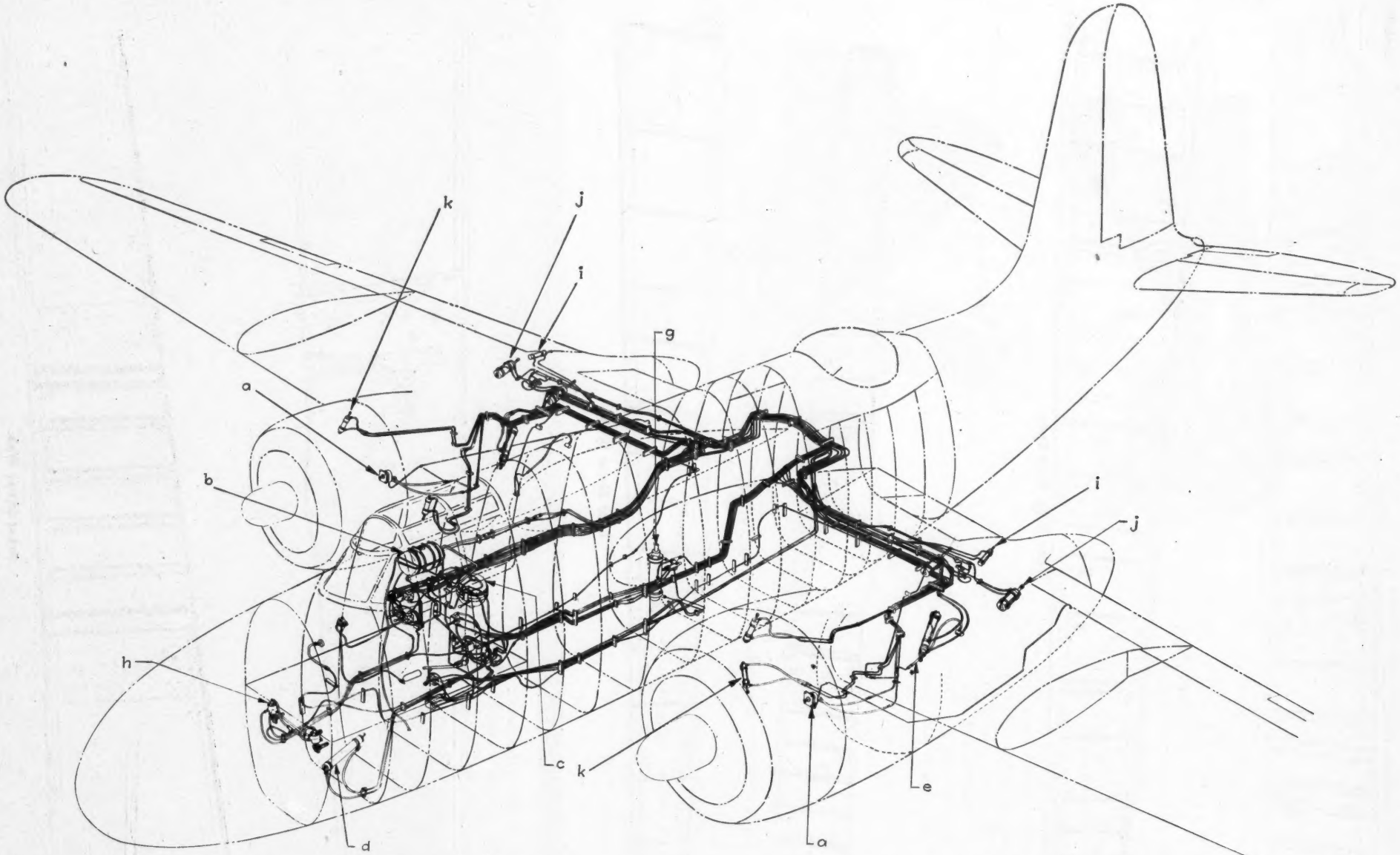


Rear Shear Web.





Front Shear Web.



Hydraulic system is supplied with liquid under pressure by pumps, *a,a*, drawing supply from reservoir *b*, through regulating valves in front bomb bay which keep pressure between 825-875 psi. Check valves retain pressure in case of pump failure or leakage. Fluid passes to pressure accumulator *c*, and thence to selector valves for various systems—landing gear, bomb doors, brakes, wing flaps and cowl flaps. By-pass operates when pressure exceeds 1025 psi. Rear wheels are operated by cylinders *e* and front wheel by cylinder *d*. Bomb doors are opened and closed by large vertical cylinder *g* in center of fuselage. Brakes are controlled by brake control valve *h*, which admits pressure to the system. Cylinders *i*, actuate inboard flaps and *j* the outboard. The cowl flaps open and close by action of cylinders *k,k*. Fluid return lines lead back to reservoir *b*.

under the fixed section to allow access to the upper .50 cal. flexible gun. The upper gun is stowed in a tunnel immediately aft of the movable enclosure and is accessible through two doors on top of the fuselage operated from the gunner's compartment. The cockpit enclosure can also be used as an exit either in the air or in the event of a landing on the bottom of the fuselage, with wheels retracted. The door and sliding enclosure are operable from either side.

Arrangement of the rear gunner's compartment allows freedom of movement of both gunners. A seat supported on a pedestal type structure is provided for the upper gunner, whereas the rear gunner's seat is made of a cushion located just forward of the access door on the floor. Safety belts are, of course, provided.

The fuselage is fared upward from the bottom line of the constant section to the aft extremity to provide good aerodynamic design, to raise the empennage control surfaces above wing turbulence and slipstream, and to provide clearance for the tail section during landings with the tail down.

Of conventional design, the fuselage tail cone is constructed as a single unit. Frames are formed 24SOal or 24STal aluminum alloy with extruded 24ST longitudinals to tie them together. Covering is of 24STal sheet. The cone attaches to the main fuselage structure, just aft of the rear gunner's compartment, by means of six internal wrenching bolts.

The wing, of full cantilever aluminum alloy construction, has a single spar and two shear webs. It is the NACA 23018 section tapered to NACA 23010 at the tip, selected because of its very stable center of pressure and high L/D.

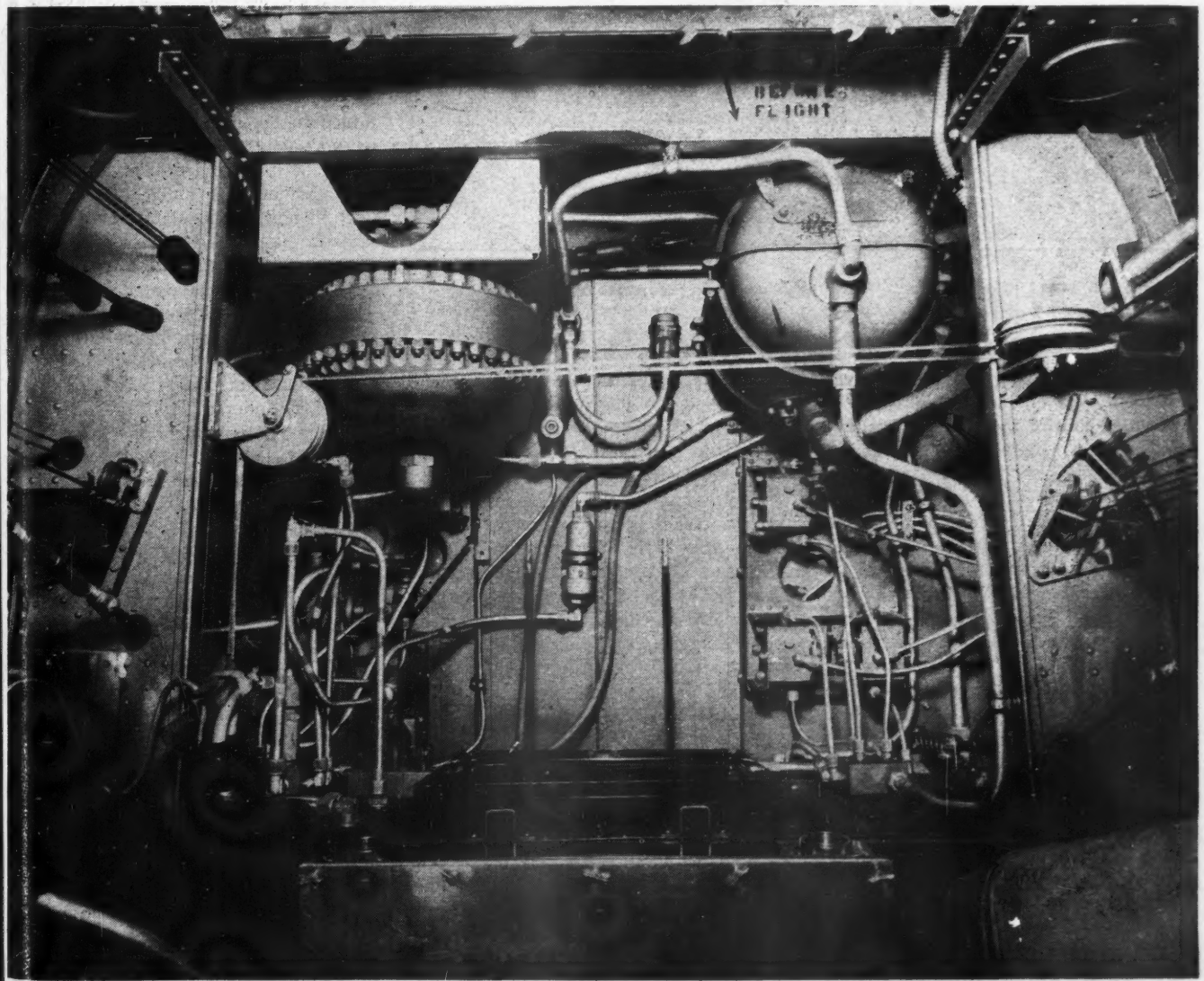
It is built up in six major sections: Left and right inner panels, extending from the fuselage junction to approximately 60 in. beyond the center-line of the nacelles; left and right outboard panels, similar in construction to the inner ones and extending to a point approximately 30 in. inboard of the tip; and the left and right wing tip assemblies which complete the wing.

Inboard wing panels are connected to the fuselage structure by aluminum alloy fittings and close fitting steel bolts in shear. The outboard and inboard panels are joined by tension bolts at the center spar and by shear bolts at the forward and aft shear webs. The wing tips are attached to the outboard panels by means of flush screws and anchor nuts.

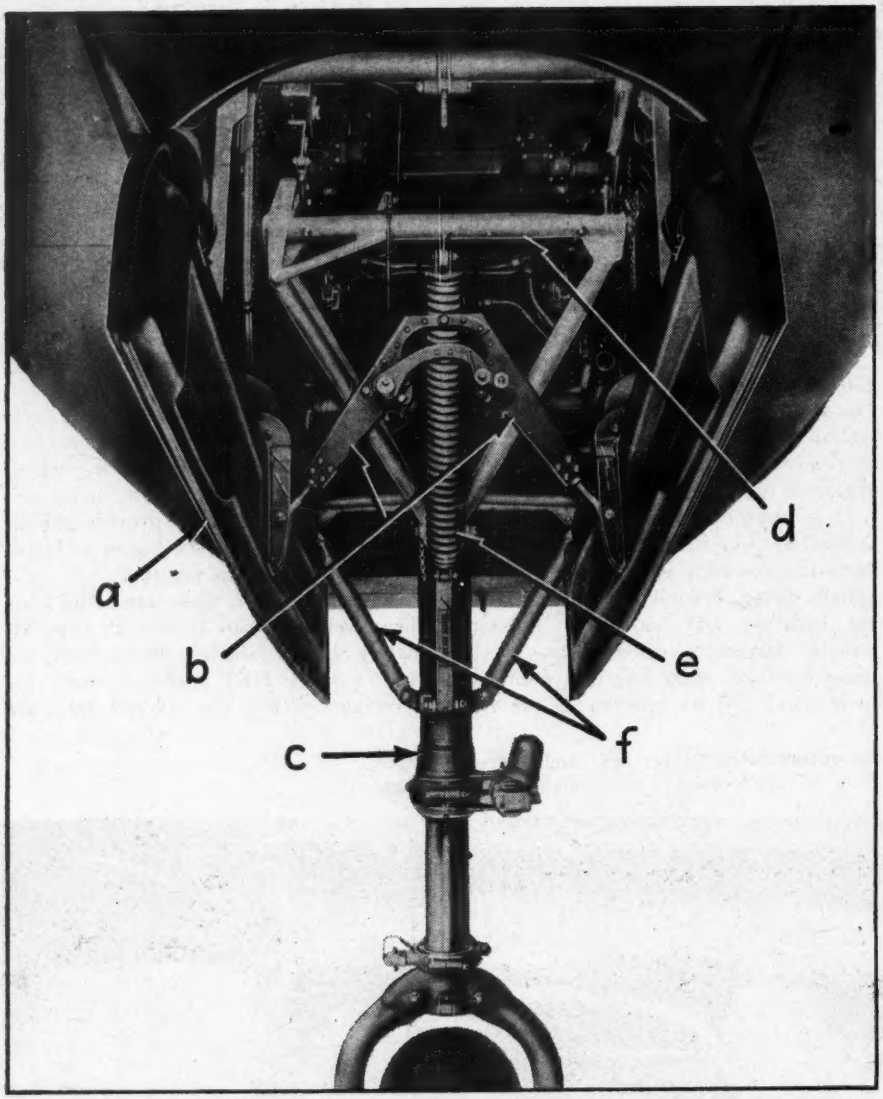
The single Wagner spar carries all bending loads. Wagner type ribs and arch channel formers, spaced a maximum of 15 in. apart, are attached to the spar and extend to the leading and trailing edges. Span-wise stiffeners are attached to the ribs and formers, which support the skin. All exposed wing surfaces are flush riveted to provide smooth contours and make the plane as aerodynamically clean as possible.

Ailerons have a main spar and rear shear web with ribs spaced at approximately 12-in. intervals throughout the span. Sheet 24ST Alclad is used for covering. While the aileron tabs are

Hydraulic accumulator (upper left) and reservoir (upper right). View looking forward to front bulkhead of bomb bay.



leakage. Fluid passes to pressure accumulator *c*, and thence to selector valves for various systems—landing gear, bomb doors, brakes, wing flaps and cowl flaps. By-pass operates when pressure is built up in the system. Cylinders *i*, actuate inboard flaps and *j* the outboard. The cowl flaps open and close by action of cylinders *k,k*. Fluid return lines lead back to reservoir *b*.



Front landing wheel. At *a*, nose wheel door, *b* adjustable yoke, *c* shock strut, *d* cross beam, *e* spring burgee, *f* side brace strut.

part of the aileron proper, they may be operated with or independently of the aileron to control the airplane's balance in flight. The aileron is mounted on three hinged brackets at the rear shear web of the outer wing, so arranged that removal and assembly may be performed without removing the wing from the airplane. Ailerons are statically and dynamically balanced by means of lead weights in the leading edge and trim tabs are adjusted from the pilot's cockpit.

Horizontal stabilizer of the craft is of two-piece, all metal, full cantilever design permitting interchangeability, left with right, simplifying both supply and manufacture. It attaches to the fuselage with tension bolts, and is given 10 deg. dihedral to elevate the tips above the wake of the engine nacelles.

Elevators are riveted aluminum alloy frames covered with doped fabric held in place with flush attachments. The framework consists of a deep built-up spar near the leading edge and channel ribs connecting the spar to a metal trailing edge. The nose section of the elevator is covered with light 24ST Alclad to form the leading edge and torque cell attached to the torque tube.

Approximately 25 percent of the elevator area is located forward of the hinge line for aerodynamic balance. Elevators are dynamically and statically balanced by the addition of lead weights in the leading edge, left and right being interchangeable. Trim tabs have approximately 5 percent of the elevator area and are adjustable from the pilot's cockpit.

Vertical stabilizer is of full cantilever design and is attached to the fuselage by means of tension bolts.

Like the elevator, the rudder is a riveted aluminum alloy frame, fabric covered, with approximately 22 percent of its area forward of the hinge line. It, too, is balanced by means of lead weights in the leading edge. Trim tabs have 5 percent of rudder area and are adjustable in flight from pilot's cockpit.

The single type of vertical fin and rudder was chosen because it was believed to be less subject to flutter in case of combat damage, also because of its greater simplicity of manufacture and its better drag coefficient.

Sealed ball bearing hinges are used for all control surfaces. Carbon steel flexible cables with swaged fittings and ball bearing pulleys connect them to the control wheel and pedals in the pilot's cockpit, the only point of control in the airplane.

Lift and drag increase is achieved by means of conventional flaps, synchronized through constant flow valves in the hydraulic control system that permit a constant and even flow to each operating cylinder. The flaps shorten the takeoff run approximately one-fourth and increase the angle of glide about the same amount, decreasing landing speed approximately 20 percent. They have an average chord of 22 in. and a length of 109 in. each and may be depressed a maximum of 45 deg. For takeoff under severe conditions, flaps are set at an angle of 22½ deg.

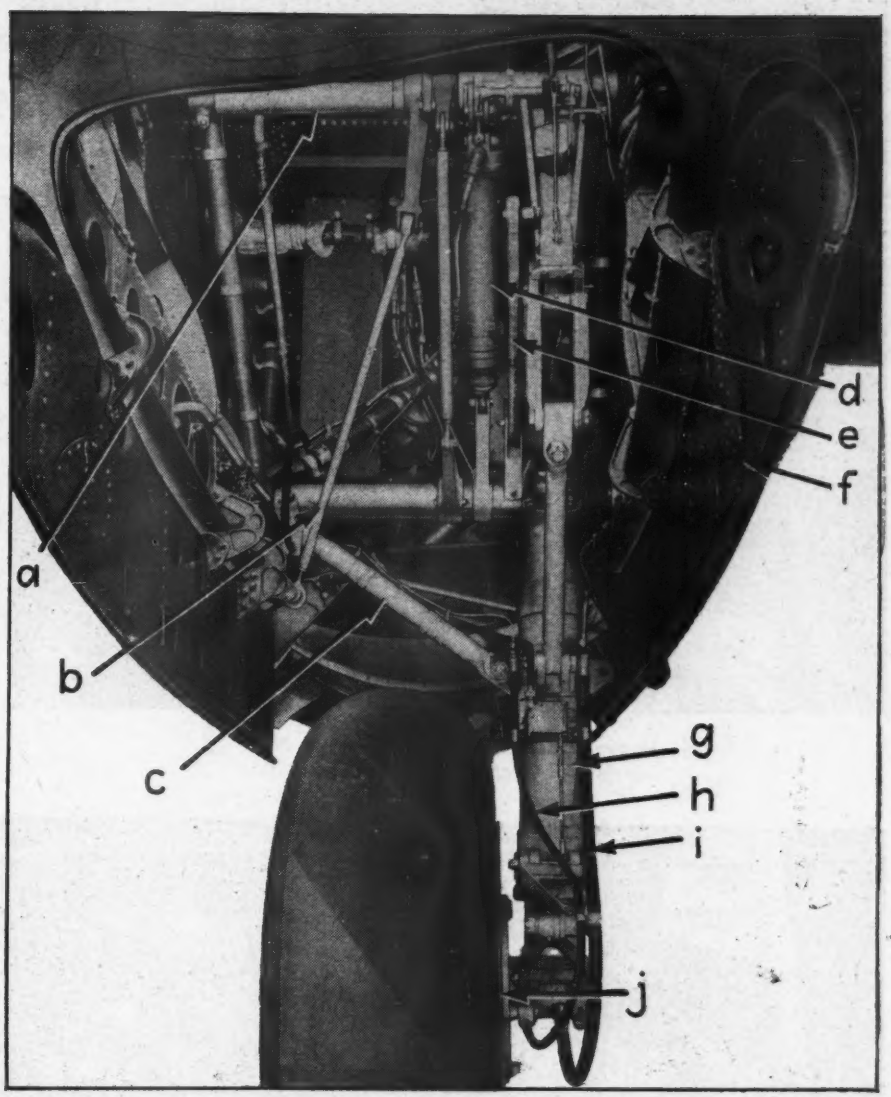
Nacelles are of semi-monocoque all-metal construction with channel type frames and extruded longitudinal stiffeners. A stainless steel firewall is provided between the engine and the nacelle structure. Inner wings and nacelles are constructed separately and then are joined in the first stations of the inner wing assembly line.

Engine mounts are of welded chrome molybdenum steel tubing, bolted to support fittings at the front shear web of the wing and to a combination engine mount and landing gear support frame near the lower surface of the nacelle. Vibration isolators are installed between the engine and the engine mount. Engine cowling, made of formed sheet, extends to a point immediately aft of the rear row of cylinders. Hydraulically operated cowl flaps control the flow of air. Accessory cowling is attached to the firewall and the diaphragm by quickly detachable fasteners.

The A-20 was one of the first U. S. military planes to be equipped with a tricycle landing gear. U. S. Army authorities had foreseen the need for a gear that would make possible operations from unpaved and otherwise hazardous airfields close to the fighting fronts, hence it was stipulated that the attack bomber desired should be so equipped.

Completely retractable and hydraulically operated, the landing gear has a main wheel tread width of 203½ in., a wheel base of 165 in., and type II smooth contour wheels equipped with disk type hydraulic brakes. Main wheel and tire size is 44 in. and nose wheel and tire is 26 in. Each main wheel is mounted on a single, braced, oleo-pneumatic strut, and the nose wheel is

Rear landing wheel. At *a*, support shaft, *b* door control rod, *c* brace, *d* actuating cylinder, *e* bungee ring, *f* nacelle door, *g* shock strut, *h* hydraulic brake hose, *i* emergency air brake hose, *j* wheel and brake.

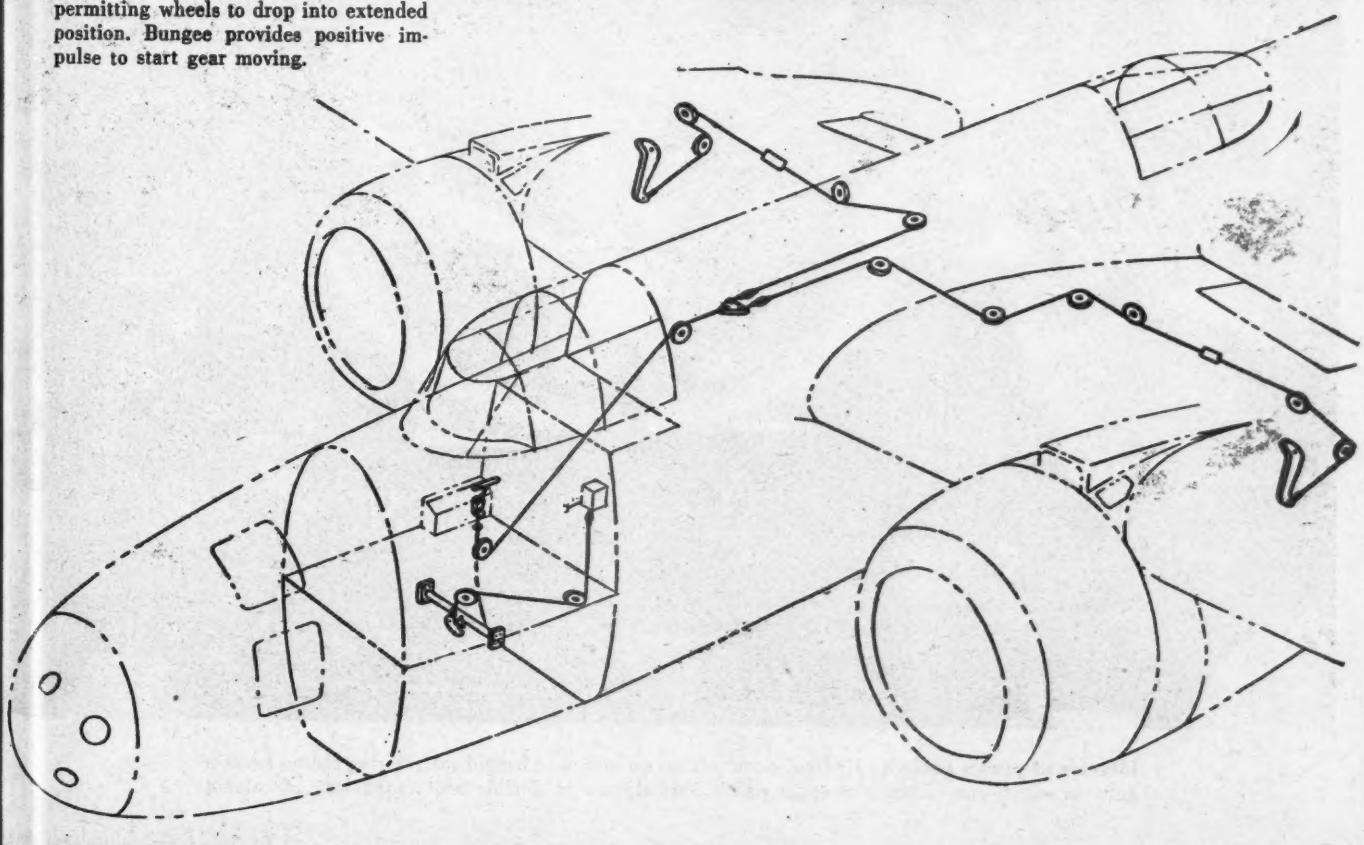


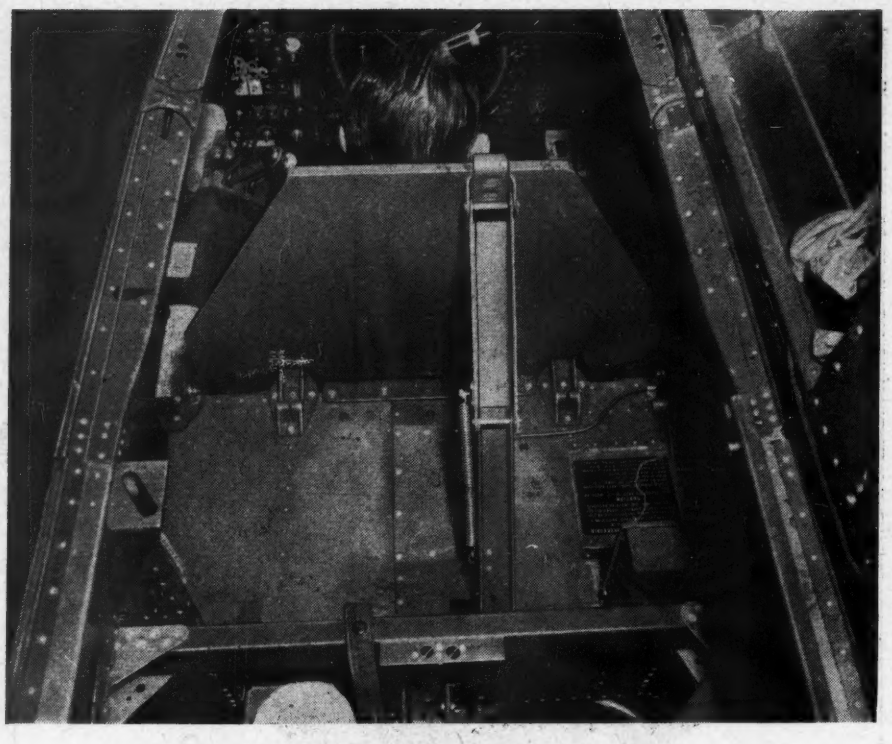
mounted on a single cantilever oleopneumatic strut. For normal operation the nose wheel is limited to a movement of 30 deg. each side of center by a hydraulic snubber, but a mechanism is provided to allow full 360 deg. caster for ground handling.

Main wheels retract up and aft into the nacelles, while the nose wheel retracts up and aft into the fuselage, and all are completely enclosed when retracted. Retraction and extension of all three wheels is simultaneous and actuated by the same control system. Brakes are pressure operated and individually controlled by pedals integral with the rudder pedals in the pilot's cockpit. A parking brake, operated from the cockpit, is also provided. Positive hydraulically operated mechanical locks hold the gear in the extended position. Positive extension of the landing gear in case of failure of the hydraulic system is accomplished by a bungee system and an emergency pull handle to disengage the gear lock-up mechanism.

A position indicator, red and green warning lights, and warning horn indicate the landing gear position at all times.

Landing gear mechanical release, permitting wheels to drop into extended position. Bungee provides positive impulse to start gear moving.





Heavy folding back armor for pilot. Nothing short of 40 mm. shell can penetrate this.

Hydraulic system of the A-20 is the "medium pressure" type, consisting of two engine-driven pumps (either of which can furnish the required pressure, one serving as a "stand by"), a hydraulic fluid reservoir, and a pressure accumulator. A hand pump furnishes pressure for ground operation, when the engines are not being run, and for emergency pressure in the air or in landing. The

Instrument Installation

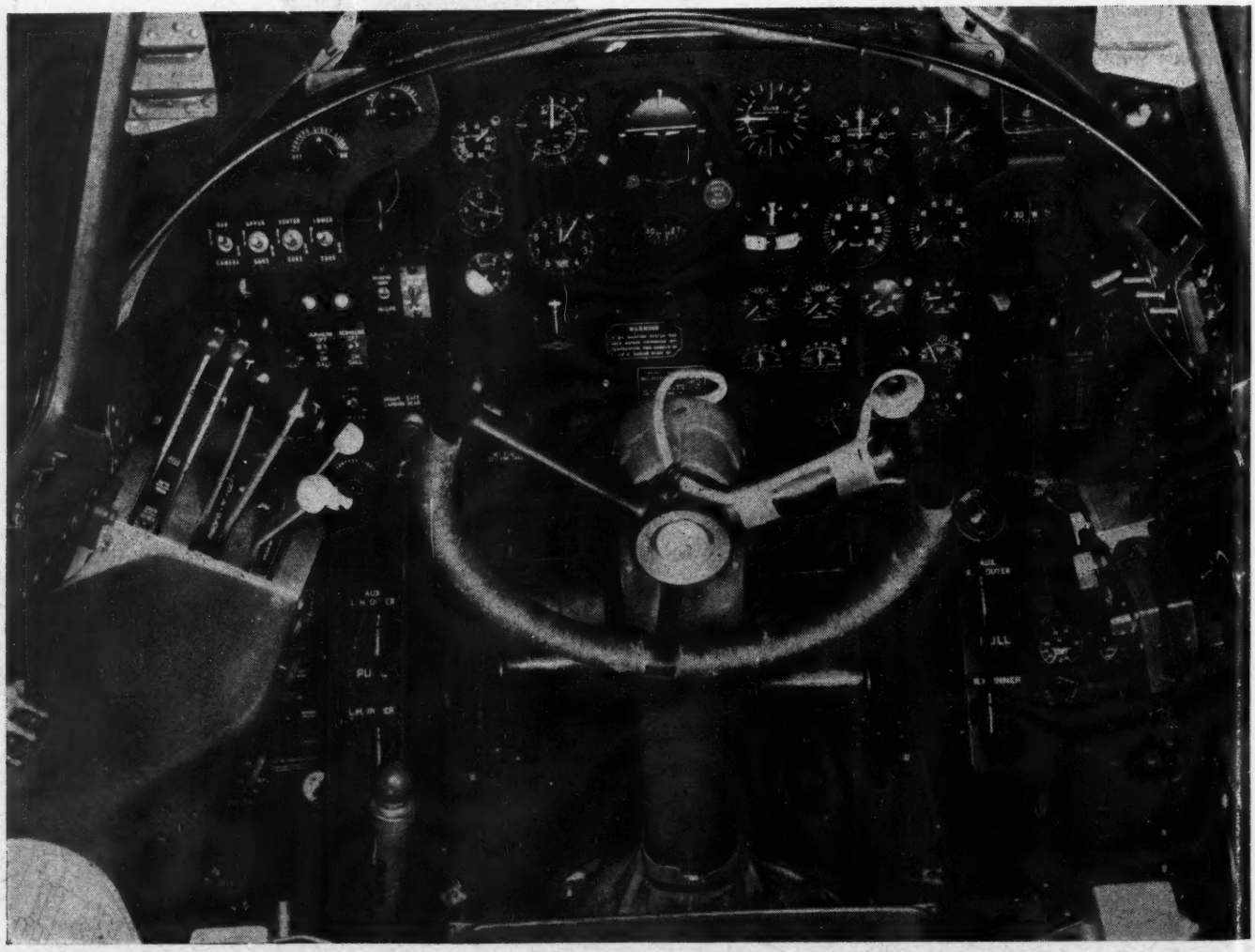
Flight Instruments
Airspeed Indicator — Altimeter — Clock—Turn and Bank Indicator—Suction Gauge—Compass—Flight Indicator—Turn Indicator—Outside Air Thermometer—Rate of Climb Indicator.

Engine Instruments
Tachometers, 2—Oil Temperature Indicators, 2—Manifold Pressure Gauges, 2—Engine Temperature Indicators, 2—Oil Pressure Gauges, 2—Fuel Pressure Gauges, 2—Carburetor Mixture Temperature Indicators, 2—Fuel Quantity Indicator.

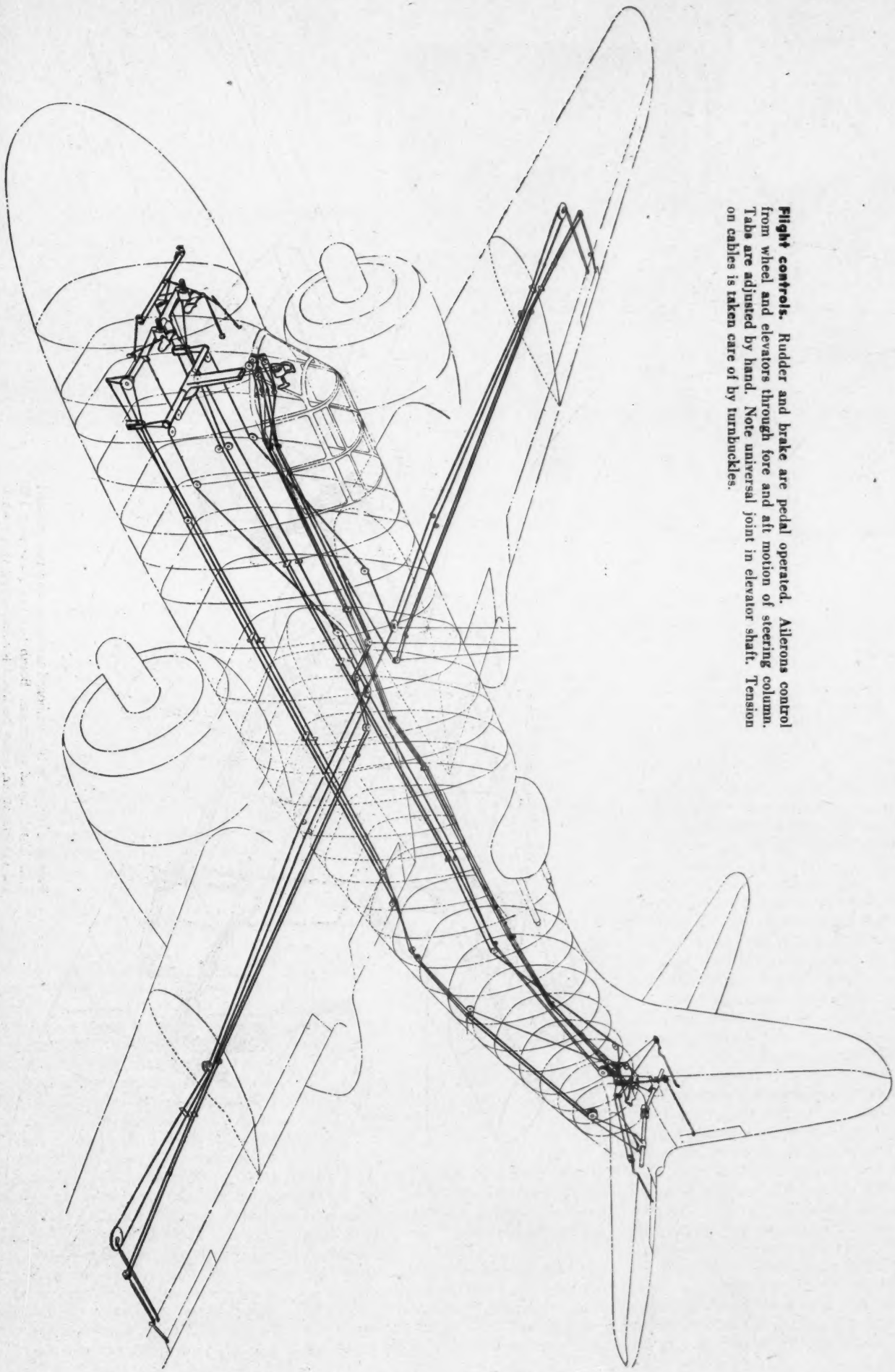
Miscellaneous Instruments
Hydraulic Pressure Gauge—Indicator Unit for Landing Wheels and Wing Flaps.

Navigation Instruments
Mark 11 Drift Recorder (rear cockpit, stowed)—Mark 11 Astro Compass (rear cockpit, stowed).

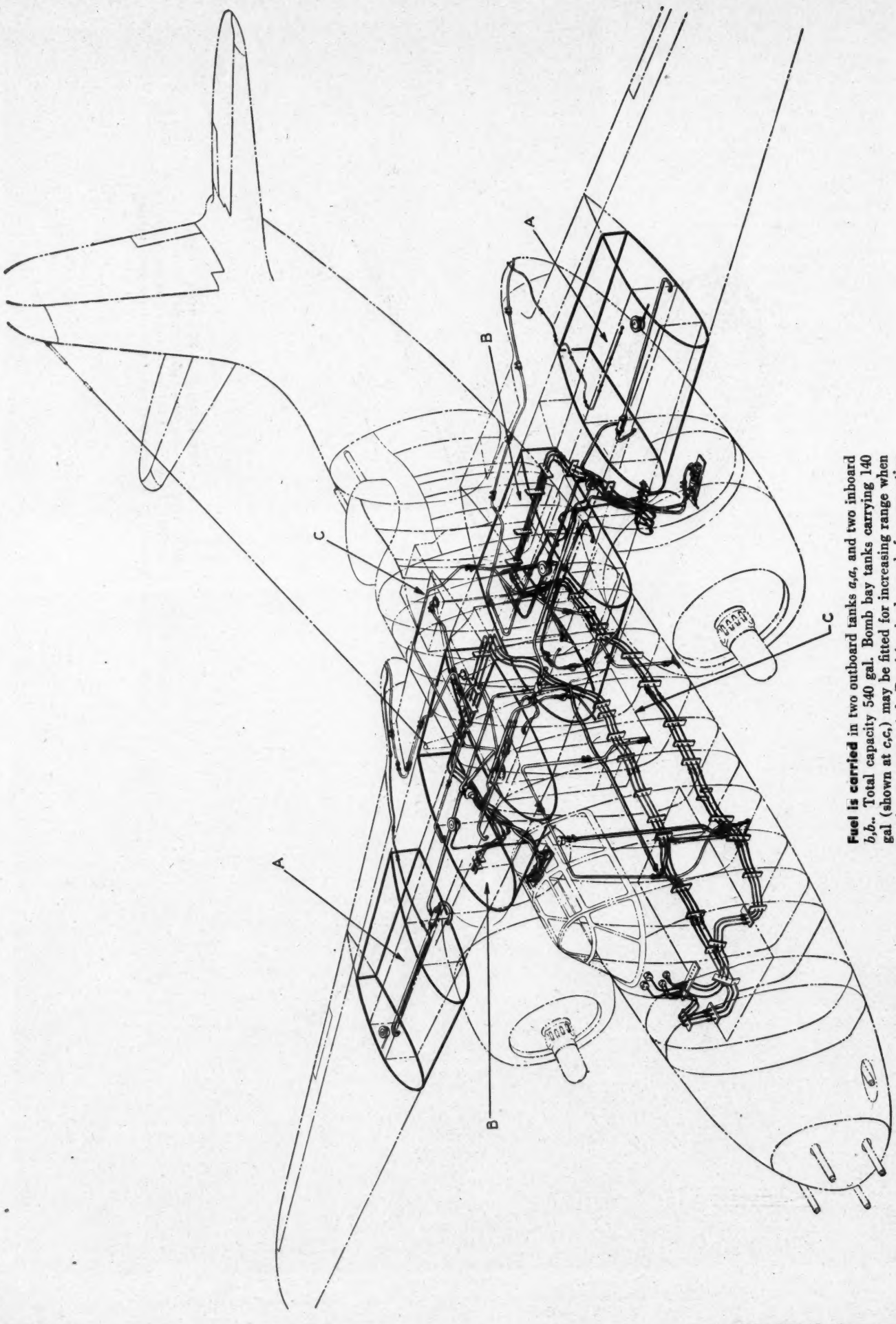
Radio Units
One, SCR-274 Command Set
One, SCR-535 Identification Set
One, RC-36 Interphone System
One, MN-26 Radio Compass



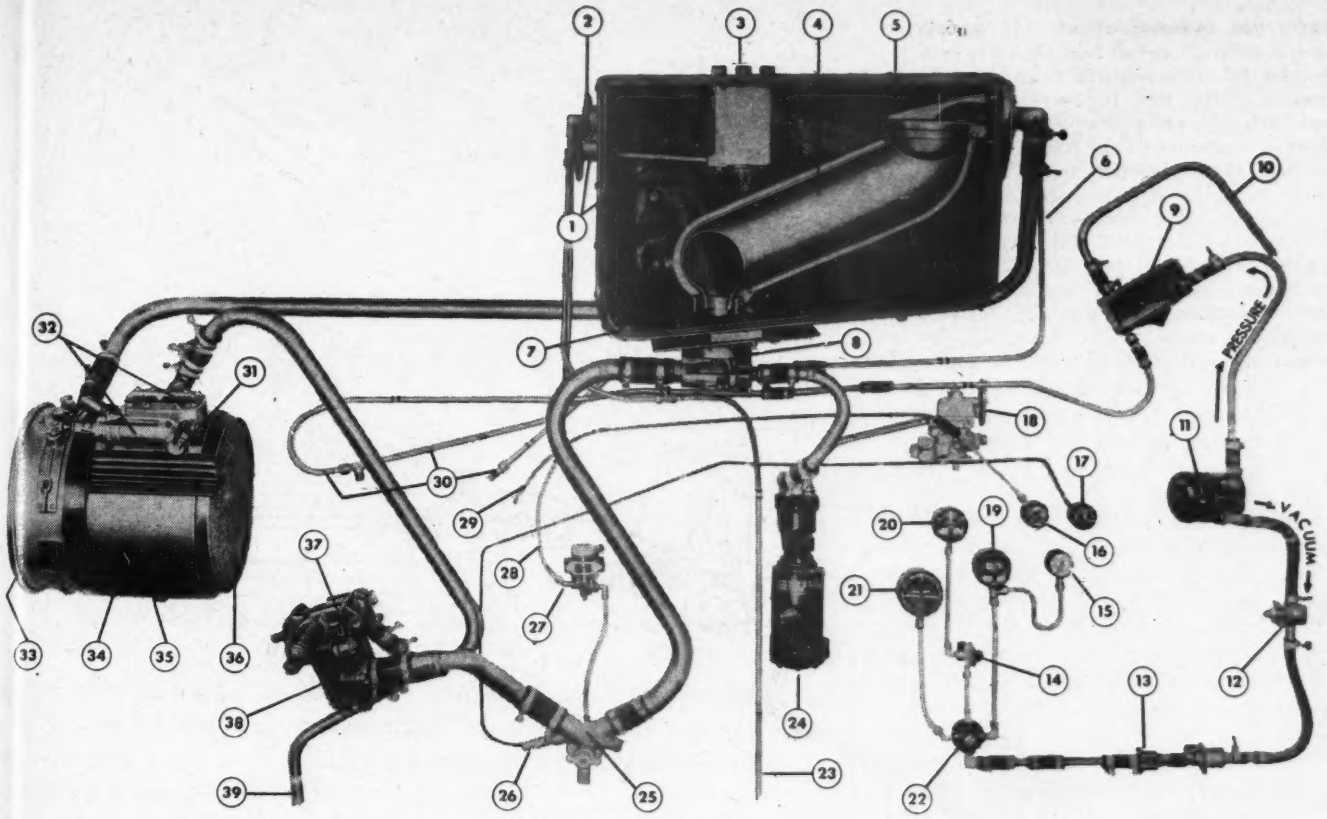
Interior of pilot's cockpit. Hydraulic controls are on bulkhead behind seat. Firing button for nose guns on wheel, gun switches at upper right. Note zippers on flexible boot round base of column.



Flight controls. Rudder and brake are pedal operated. Ailerons control from wheel and elevators through fore and aft motion of steering column. Tabs are adjusted by hand. Note universal joint in elevator shaft. Tension on cables is taken care of by turnbuckles.



Fuel is carried in two outboard tanks *a,a,* and two inboard *b,b,.* Total capacity 540 gal. Bomb bay tanks carrying 140 gal (shown at *c,c,*) may be fitted for increasing range when bombs are not carried. Provision is also made for connecting a "dropaway" belly tank to increase range still farther.



Engine oil systems are separate; hopper type, to free oil from air and dilution vapors. (1) Filler cap overflow, (2) tank top vent, (3) filler cap, (4) hopper, (5) supply tank, (6) vent, (7) divided channel standpipe, (8) sump adapter, (9) oil separator, (10) line to atmosphere, (11) vacuum pump, (12) suction relief valve, (13) flapper valve, (14) turn and bank relief valve, (15) suction gage, (16) oil pressure gage, (17) oil temperature gage, (18) prop feathering governor, (19) gyro-compass, (20) turn and bank indicator, (21) artificial horizon, (22) master relief valve, (23) filler cap overflow, (24) prop feathering electric pump, (25) "Y" drain, (26) oil temperature bulb, (27) oil dilution solenoid valve, (28) line from carburetor, (29) oil pressure line, (30) overflow to engine sump, (31) viscosity valve regulating screw, (32) viscosity valve, (33) shutter, (34) oil cooler, (35) sump plug, (36) cooling tubes, (37) pressure regulating screw, (38) engine oil pump, (39) scavenger line to engine pump.

hydraulic systems operate the landing gear, wing flaps, cowl flaps, bomb bay doors, and the main landing gear brakes.

Each engine is provided with a separate lubrication system. Oil tanks have a net capacity of 23 U. S. gal. plus a 3 gal. air space, and they are of self-sealing material designated as U. S. Rubber Co. material No. 143. A partial circulation hopper is in each tank. Oil coolers with automatic self-closing shutters are also provided in each nacelle, where the oil tanks are also located, in the upper portion along the center line of each engine. Each lubrication system has electrically controlled oil dilution, and oil tanks incorporate provisions for the installation of an electrically operated immersion type heater, supplied with current from an external source.

Fuel is carried in two pairs of wing tanks and two removable fuselage tanks. Wing tanks are equipped with detachable sump plates and finger screens which are removable without disconnecting the fuel lines. The main fuel supply is drawn from the wing tanks through finger screens at each end of the main tanks and interconnected by means of a selective sump valve for each tank. Wing tanks are individually vented, and overflow is discharged at the aft end of each nacelle. Each inboard tank is provided with an emergency dump valve.

The fuselage fuel tank consists of two separate containers installed above the bomb bay and interconnected by lines which equalize the level of fuel in them. An electrically driven booster pump, controlled from the pilot's cockpit, and a pump adapter with a flange to provide a sump, complete the installation. Vents are interconnected and discharge at the high point of the airplane in normal flight or at rest on the ground.

Each power plant is normally supplied by its own independent fuel system, but these may be interconnected by the pilot on either the suction or pressure side of the engine fuel pumps, so that each engine can be supplied from any wing tank, or both engines can be supplied by one fuel pump. The fuselage fuel tank is connected into the left-hand tank selector valve, so that fuel from the fuselage tank may be supplied to either or both engines.

The engine driven fuel pumps are mounted directly on the engines, and fuel is supplied from the suction side of the pump through the selector valves and strainers. Hand fuel pumps and cross-feed valves are located in the fuselage, with fuel valves operated by cable and rod controls and the hand pumps by rod controls. Gages are of the electric remote indicating type and are located on the instrument panel. The transmitter unit is installed in the tank.

Horsepower Ratings

Wright GR-2600 with 16:9 gear ratio and PD-12K1 carburetor.

Military ratings:
1,600 at 2,400 r.p.m. to 1,000 ft.
1,400 at 2,400 r.p.m. at 10,000 ft.

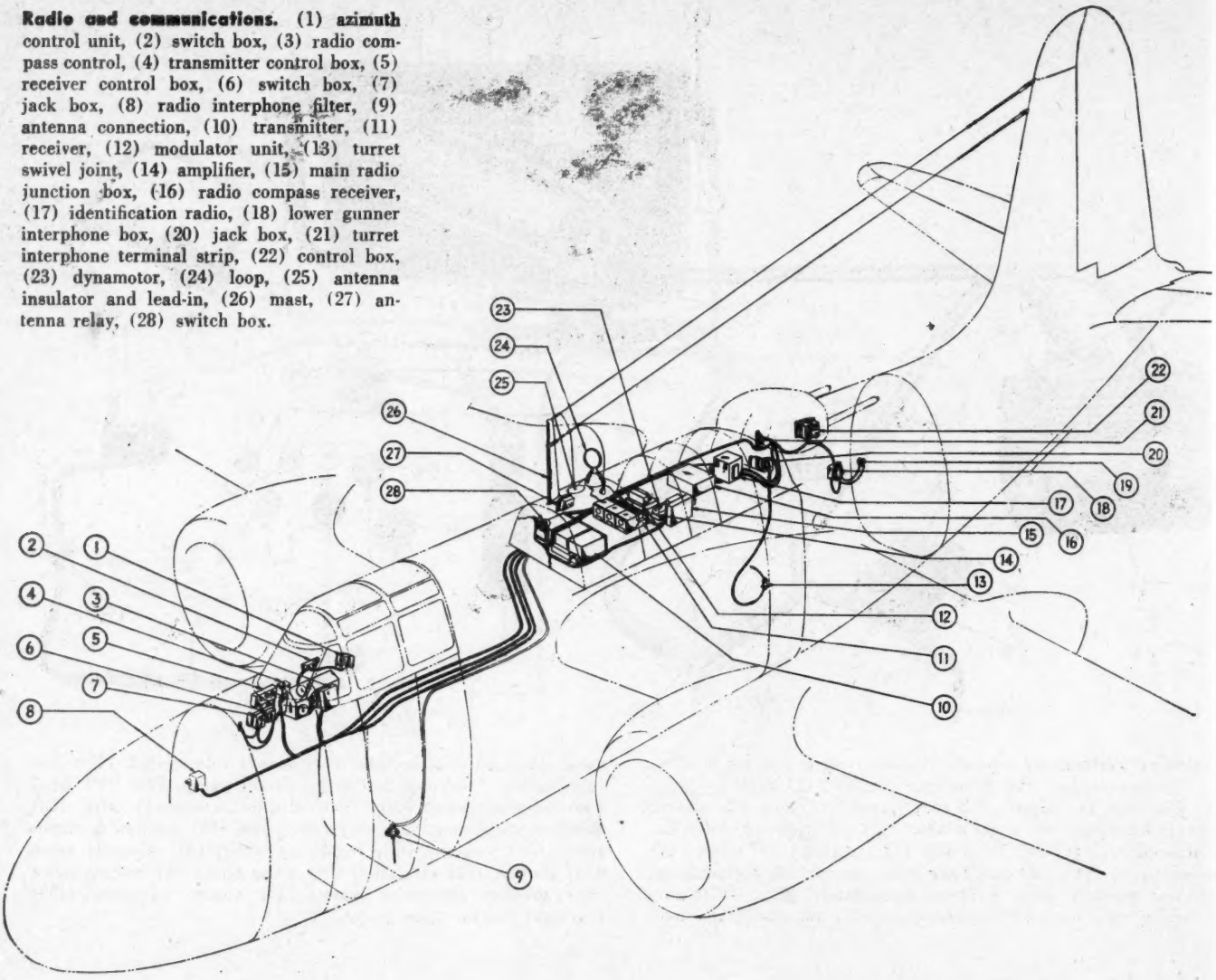
Normal ratings:
1,350 at 2,300 r.p.m. at sea level
1,350 at 2,300 r.p.m. at 5,000 ft.
1,275 at 2,300 r.p.m. at 11,500 ft.

Propeller Data

Hub manufacturer ....Hamilton Standard
Hub model no.....23E50
Blade manufacturer .. Hamilton Standard
Blade design no.....6353A-21
Type ..... Hydromatic Full Feathering
Diameter ..... 11 ft. 3 in.
Number of blades 3
Minimum pitch limits: Constant speed
Maximum pitch limit: Full feathering
Minimum clearances:
In plane of each propeller disk:
To ground, level landing.....9½ in.
To fuselage .....9 in.
Normal to plane of each propeller disk:
To cowling at maximum pitch. ½ in.
To leading edge of wing.....33 in.

bombs are not carried. Provision is also made for connecting a "dropaway" belly tank to increase range still farther.

Radio and communications. (1) azimuth control unit, (2) switch box, (3) radio compass control, (4) transmitter control box, (5) receiver control box, (6) switch box, (7) jack box, (8) radio interphone filter, (9) antenna connection, (10) transmitter, (11) receiver, (12) modulator unit, (13) turret swivel joint, (14) amplifier, (15) main radio junction box, (16) radio compass receiver, (17) identification radio, (18) lower gunner interphone box, (20) jack box, (21) turret interphone terminal strip, (22) control box, (23) dynamotor, (24) loop, (25) antenna insulator and lead-in, (26) mast, (27) antenna relay, (28) switch box.



Side view shows relation of engine nacelle to cockpit and nose section indicating excellent vision.

Armor and armament have, of course, changed considerably since the first A-20 was designed, and they will probably continue to change throughout the period of the war, and possibly afterward. But despite the ever increasing weight and amount of both armor and armament, this constant change has not required a major basic alteration in the airplane. Naturally, the switch from .30 to .50 cal. machine guns and to 20 mm. cannon, on some models, has required variations in the structures of the nose sections, and a minor change in the fuselage just aft of the bulkhead where the nose attaches, for a distance of approximately 30 in. aft, because of the greater weight of the nose. However, no changes were required in the main fuselage or wing structures.

The A-20 was designed to carry unusually heavy loads for the size of its wings and power, and it was built to take off from short fields. This basic design decision has made possible operations in which it is not uncommon for A-20's to take off from short, advanced bases with as much as 50 percent overload.

★

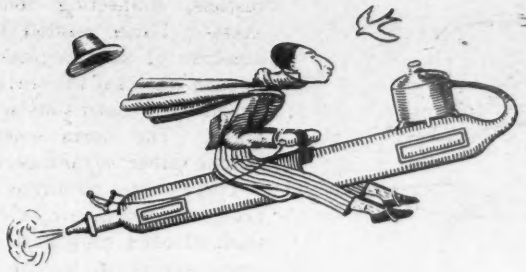


Fig. 1. One of many cartoons of Golightly's idea for a steam-jet craft (about 1855). This saddled sky-horse was sometimes shown with wings and tail.

JET PROPULSION From Fancy to Fact

Part I

By **WILLY LEY,** *Formerly Vice-President, German Rocket Society*

Those now working to achieve practical reaction-principle flight owe much to the painstaking trail blazing of yesterday's rocket experimenters. . . . First installment of a revealing two-part series by a participant in the pioneering.

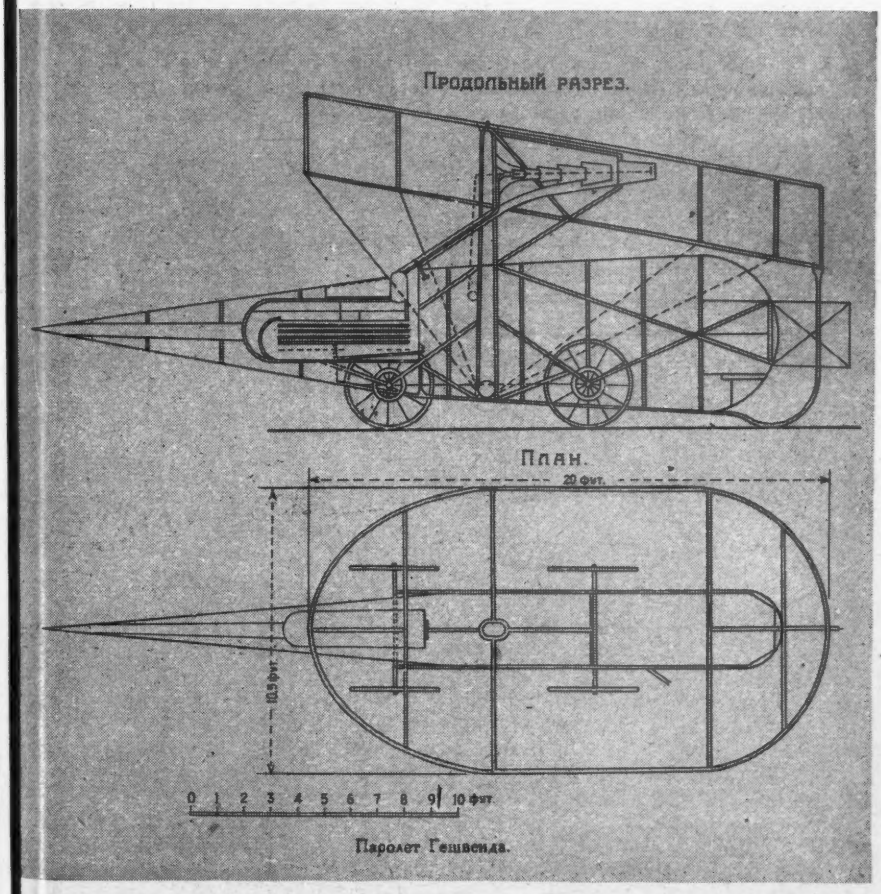


Fig. 2. Geschwend's wagon-like project was to be propelled by steam jets drawing in an additional volume of air to augment volume projected rearward. It was designed with multitubular boiler and four-wheel landing gear, and speed was to have been regulated by T-shaped baffle at outlet of large jet. Angle of planes would have been changed by rocking them.

A LITTLE OVER 100 YR. AGO, a British engineering journal published an article violently attacking certain new plans concerning railways and locomotives. It concluded with the sentence: "It would be difficult to conceive of anything more silly and ridiculous than the idea of building locomotives of twice the average speed of a mail coach. One may just as well expect the inhabitants of Woolwich to give their consent to a ride on a Congreve war rocket than to entrust their lives to such an engine."

The immediate result of this attack was that Stephenson named his next locomotive the *Rocket*. But the joke on the article writer had only just begun, since soon afterward inventors seriously began to consider Congreve war rockets —minus the incendiary or explosive head—as a possible means of transportation.

A considerable number of projects concerning rocket airplanes and rocket airships were advanced during the latter half of the Nineteenth Century. But while these projects are both interesting and amusing, they can all be disregarded in a modern discussion of the application of the rocket principle for aviation since the originators did not really have a free choice.

They did not think of rockets as a means of propulsion for their various "flying machines" because of any special merit of this method. Their choice was simply dictated by necessity, for they did not have any other prime mover at their disposal save clockwork, which was immediately discarded as too weak, and the steam engine, which was too heavy.

Several of these men were, however, intrigued by steam, although not in the form of an engine. A British patent for an airplane propelled by steam reaction was granted to one Charles Golightly in 1849. Unfortunately, we do not know who Charles Golightly was, nor do we know anything about his plans, except for a contemporary cartoon which has become quite famous (Fig. 1.).

It seems that Golightly wanted to build something similar in outline to a modern monoplane, with a boiler in the fuselage, producing steam which was supposed to move the whole by direct reaction of a rearward pointing jet.

As regards the question of probable speed, Golightly seems to have made

rather big claims, for the original caption of the cartoon speaks about a "Steam Horse on Which One May Ride from Paris to St. Petersburg in One Hour." Golightly's claims must have been high, but they were "theoretically" justified — the standard of theoretical physics in 1849 permitting the conclusion that the speed of such an apparatus would have to be high.

Golightly found a somewhat belated successor in the Russian engineer Fyodor Geschwend of Kiev who, in the '80's, published two small pamphlets advocating propulsion by steam reaction. The first of these two pamphlets dealt with a steam reaction railway; the second, which is of interest here, was printed in 1887 and entitled *General Design of a Steam Airship*. This was to be a four-wheeled car suspended from two ellipsoid wings, mounted one above the other in the manner of biplanes (Fig. 2.). Its steam jet unit was to be mounted between the wings and equipped with venturi nozzles. Weight of the proposed machine was estimated at some 2,900 lb., the speed range from 80 to 150 mph.

Another Russian engineer, Alexander Gorokhov, may be credited with the first —and necessarily crude—modern design of a rocket airplane. It was published just before World War I in the Russian aviation journal *Vosdushni Put* ("Airway") and is one of the first projects where the choice of rocket propulsion is really a choice, since the airplane had by then been invented.

Gorokhov's project (Fig. 3) was a torpedo-shaped vehicle with very small wings—large stabilizing fins rather than wings. Consequently, Gorokhov advocated a high speed, mentioning the then striking figure of 220 mph. As far as general design goes, Gorokhov's project was worked out in considerable detail. The interior of the torpedo-shaped fuselage was to contain seats for pilot and passengers, as well as the fuel tanks, while the six exhaust nozzles, three on each side, were to be outside the cabin.

Gasoline and alcohol were mentioned as probable fuels and much of the propulsive mechanism was frankly based on suggestions made a few years earlier by the Frenchman René Lorin. Gorokhov knew well that the main difficulties would be the takeoff and landing of his craft, and it seems that he spent many weeks thinking desperately about these points. At any rate, the solutions which he finally advocated do look desperate. The takeoff of the machine was to be accomplished much in the manner of the take-off of a ski jumper, with a detachable wheeled carriage substituting for the skis. The landing was to take place in a large heap of the finest beach sand available. One wonders why Gorokhov, having thought of beach sand, did not then think of the sea as an even softer medium on which to land his machine.

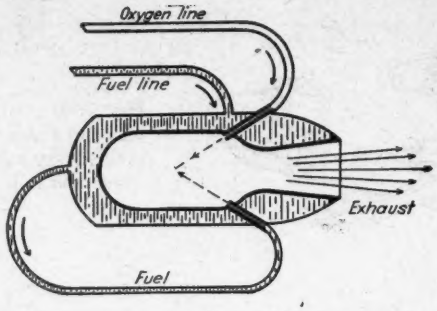


Fig. 4. German Rocket Society (now defunct) built an experimental rocket of type diagrammed here. It used alcohol and liquid oxygen, and combustion chamber was jacketed by fuel to keep it cool. There were no moving parts.

Those suggestions by René Lorin upon which, to a large extent, Gorokhov's propulsive mechanism was based had been published in the French aviation magazine *l'Aérophile* in a series of loosely connected articles, beginning in 1908. As regards the aerodynamic features, Lorin was only groping, as might be expected at that early time.

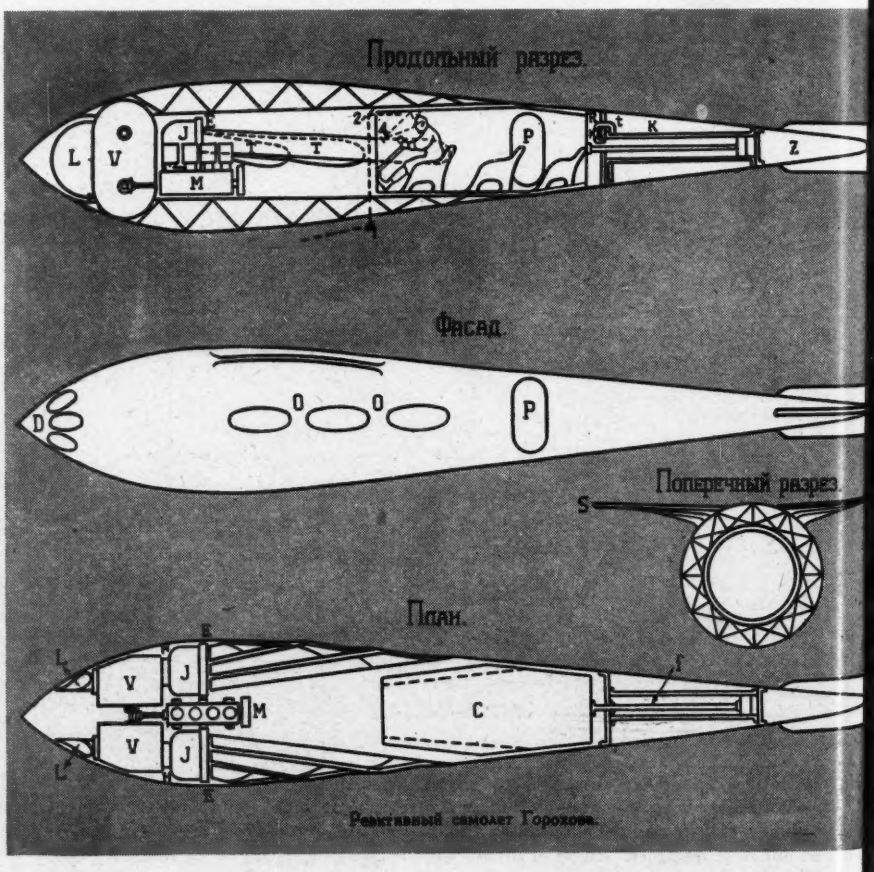
But he did have a definite idea of what he would use as a rocket motor. It was a modified six-cylinder in-line engine to be inserted in the wing. The modifications consisted mainly of the substitution of direct exhaust nozzles for the pistons, connecting rods, and driveshafts. Lorin wanted to place equal numbers of such engines in each wing in such way that the craft would be propelled by a continuous series of exhaust blasts. The Lorin scheme must have looked rather advantageous at that time.

There were no drive shafts and no need for gears or propellers. Many other things looked simplified and, all told, a great saving in weight was indicated. But these minor advantages to the contrary, it was unfortunate (for Lorin) that the single major advantage involved was represented in the already well-established engine-propeller combination.

The fact that spoke against this reaction motor and this form of application of the rocket principle to airplanes was that the engine-propeller combination also utilizes the rocket principle—and in a manner which, for this particular purpose, is far superior to the "straight" rocket.

The stream of moving air produced by the propeller can be compared directly to the exhaust of a rocket, even though it is produced in a different manner. The important differences are of a purely quantitative nature which, however, are decisive as far as efficiency is concerned. A jet from a rocket motor has a very high velocity—around 2,000 m. (7,900 ft.) per second—but its mass is small,

Fig. 3. Gorokhov design relied upon jets ejected rearward at sides near center. Pilot was to use reflecting mirrors (shown at 1, 2, 3 and 4) for forward vision. Wings were rudimentary and only intended for guiding purposes.



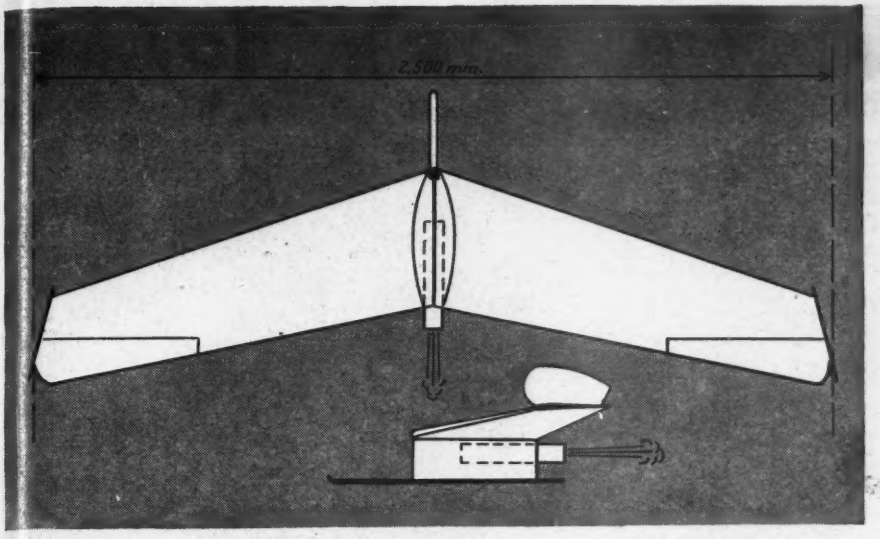


Fig. 5. *Storch* glider model flown by Rhon-Rossitten Gesellschaft. This 8-ft.-span craft was propelled with a solid rocket.

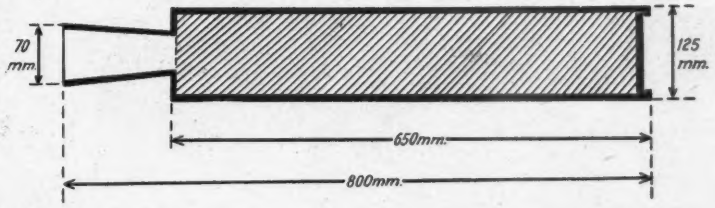


Fig. 6. Diagram of "brander" (solid powder rocket without a bore) used in Rhon-Rossitten experiments. Diameter is about 4⅞ in., length about 32 in.

on the order of a few pounds per second. The "jet" produced by a propeller has a comparatively low velocity, roughly some 20 percent of that of the rocket jet or less. But its mass is large, up to 1,000 lb. per second, in some cases even more.

While improvement of the one or the other sort of motor changes the actual figures involved, the tendency remains always the same. The better rocket motor will produce an even higher exhaust velocity without a noticeable increase in mass, while the better engine-propeller combination will produce an even more massive propeller "jet" with a comparatively small increase in speed.

But the efficiency of a jet of given mass depends almost exclusively on the speed of the craft propelled by it, so it becomes evident why the engine-propeller combination is far superior to the rocket jet for use in airplanes—unless the latter attain flying speeds far higher than those which are now customary.

Main advantage of the engine-propeller combination is that the mass composing the jet is simply taken from the surrounding atmosphere so that it does not have to be carried along. Another important advantage is the possibility of adjusting velocity and mass of the "jet" within rather wide limits.

In a rocket motor, the mass which composes the jet has to be carried along, since it consists simply of the combustion products of a fuel like gasoline or alcohol with an oxygen carrier, usually pure oxygen in the liquefied form. And while the mass of a rocket jet can be readily varied by feeding more or less fuel and oxygen into the rocket motor, the exhaust velocity cannot be varied as easily. Reducing the amount of fuel fed into the combustion chamber of a rocket motor has surprisingly little influence on the exhaust velocity, which has a tenacious inclination to remain the same for a given motor and a given fuel.

On the other hand, the rocket motor has the fascinating feature of utmost simplicity. It literally does not have any moving parts at all, consisting simply of a fuel and an oxygen line leading from the pressure tanks into a combustion chamber fitted with an exhaust nozzle. Since the combustion, while rapid and almost explosive in nature, is continuous, there is not even a need for a sparkplug. The mixture is ignited only once (through the exhaust nozzle) for each run, and this ignition may be accomplished in quite a number of simple ways (Fig. 4.)

It is not surprising, therefore, that the utilization of so simple a device as a rocket motor has intrigued engineers as well as laymen and has elicited quite a number of projects. Of these projects, only that of Dr. Eugen Sänger deserves serious consideration and discussion, since it is the only one which is based on a thorough investigation.

But before discussing Dr. Sänger's work, a number of experiments made in Germany during the years 1928 and 1929 should be mentioned. In these tests, large powder rockets were used, manufactured by the pyrotechnic firm of Friedrich Wilhelm Sander at Wesermünde, originally for Fritz von Opel's rocket automobiles and rocket railroad cars which, of course, have to be regarded merely as a means of attracting publicity. The experiments were carried out by the Rhön-Rossitten Gesellschaft, a then flourishing German glider society which received its name from the geographical locations of its two main camps.

The society furnished several glider models (Fig. 5) and a full sized glider of the then novel "duck" type with which the first recorded rocket flight

(*Turn to page* 309)

Fig. 7. Type J-33 Junkers seaplane which made first successful rocket-aided flights. This was same model—except for floats—as *Bremen* in which Koehl, Fitzmaurice, and von Huenefeld made first westward crossing of the Atlantic in 1928.

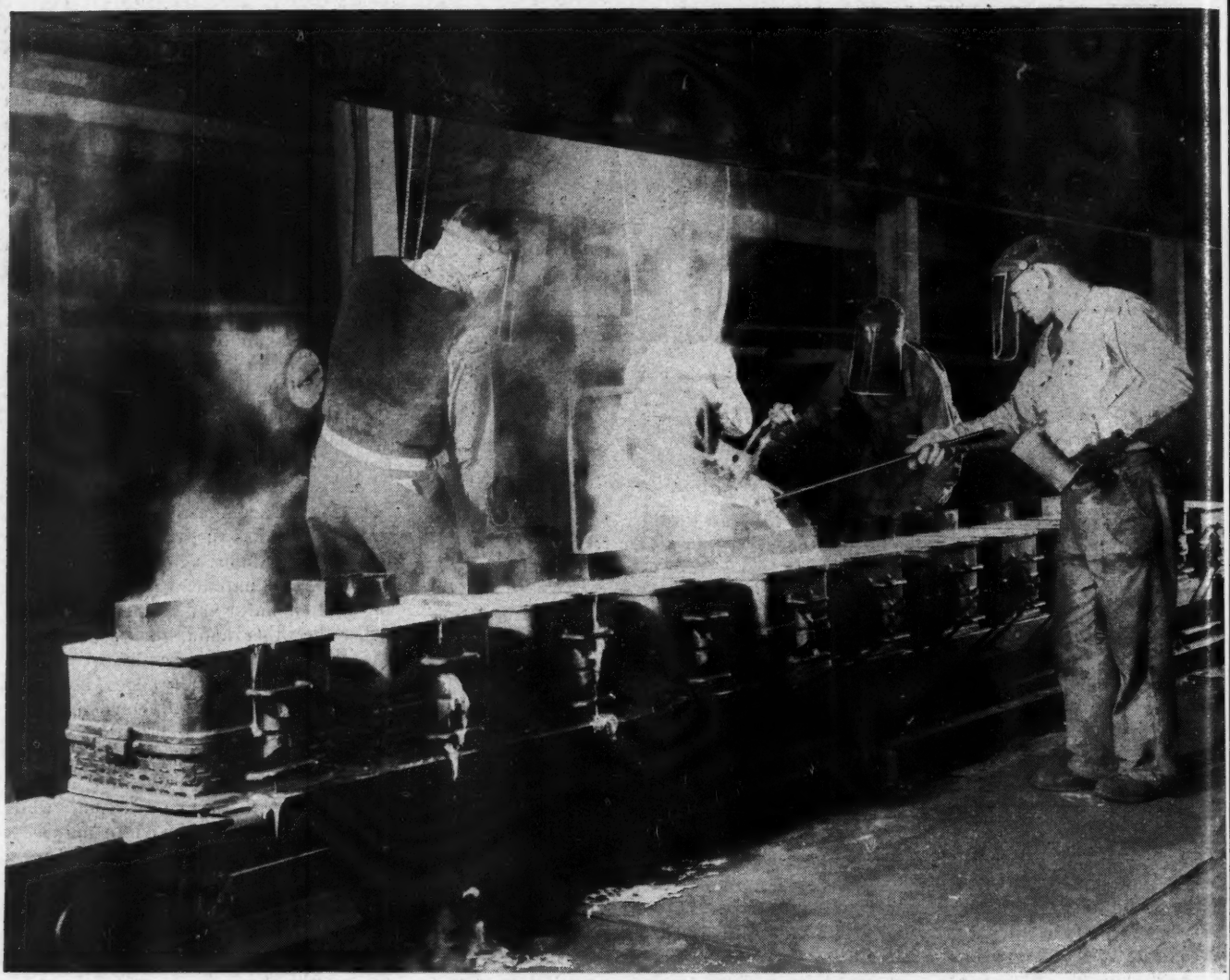


Fig. 1. Continuous pouring of airplane engine magnesium castings at Chevrolet's gray-iron casting foundry, converted from automotive to aviation use. Note that ladle moves along with flasks and has a pyrometer stuck in it so that pouring temperature can be held within range of 25 deg.

Continuous Pouring Of Magnesium Engine Castings

By CHESTER S. RICKER,
Field Editor, "Aviation"

There were problems aplenty when Chevrolet converted its iron foundry to make magnesium engine castings. But step by step the plantmen spiked the old taboo against pouring these pieces on moving conveyors. Here's how—

PRODUCTION METHODS that gave Chevrolet's gray-iron foundry top rank in the production of intricate cast iron automotive castings have been applied, so far as possible, in making magnesium airplane engine castings. A large part of the gray-iron foundry has been converted to this comparatively new operation, supplying magnesium parts for Chevrolet-built Pratt & Whitney aircraft engines for bomber and cargo planes.

According to Chevrolet foundrymen, the new methods have broken the old taboo that magnesium castings could not be poured on a moving conveyor. Careful tests have shown no difference between castings poured in stationary flasks and those made in moving ones. As a result, the foundrymen have been able to use their system of continuous pouring and attain scheduled production of magnesium castings despite the manpower shortage.

Women have helped greatly in keeping up the production schedule. They are employed in making cores and cleaning castings. The light weight of magnesium makes it possible for women to handle all castings of the size used in airplane engines.

Magnesium castings have introduced many new foundry problems. The material pours at a comparatively low tem-

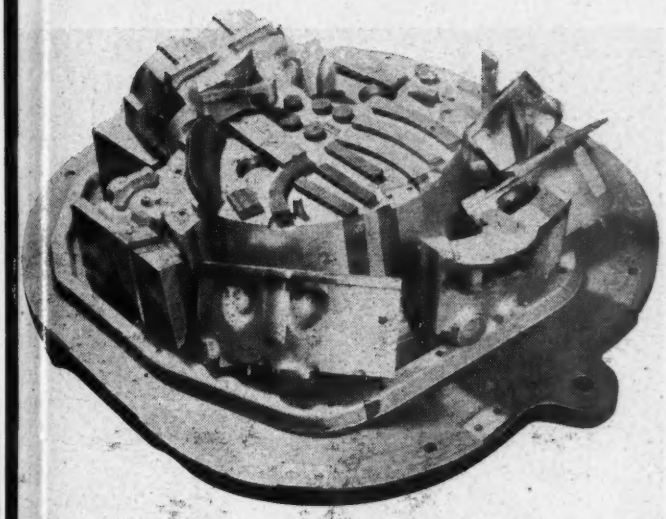


Fig. 2. Metal pattern showing all loose pieces and iron chills which are required to mold "drag" for one engine casting. For most castings, three interchangeable sets of loose pieces are required for each pattern. Thus one mold can be rammed over pattern while loose pieces are being removed from two molds previously made.

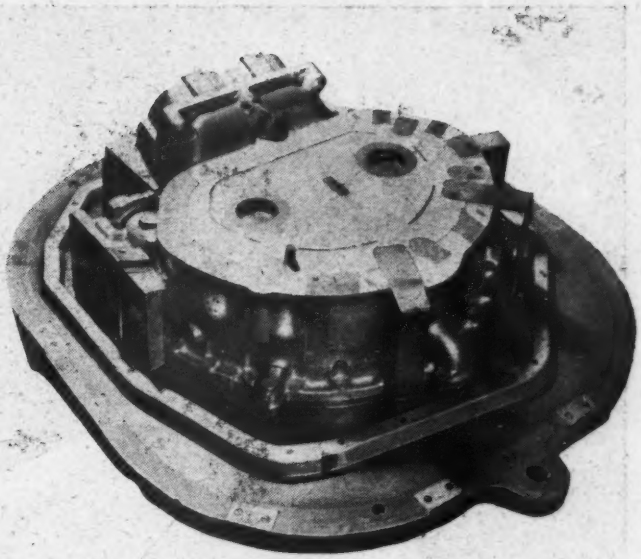


Fig. 3. Same pattern as shown in Fig. 2 after it has been assembled and is ready to be covered with sand in a flask.

perature. Because of its silvery appearance the temperature cannot be judged by its color. It is highly combustible, not only when molten but also when being machined. It has to be carefully heat treated after casting and also protected from oxidation by being chromated. Because of its low specific gravity, loose sand will not float on it as it does on iron or steel. As a result unusual care must be used in making molds lest loose sand be included in the castings.

Because of the low pouring temperature of magnesium, a new technique has been developed in core making. Cores must be made soft enough to break up naturally, since the bond is not burned out as it is when casting iron.

The molds are made from green sand and are uncoated. Fine bank sand is used to give the necessary smoothness since the mold cannot be coated with graphite or other facing materials as is customary in the casting of other metals. To prevent oxidation and the burning of the molten magnesium in the mold, the molding sand has to be impregnated with sulphur and borax. These so-called inhibitors are sprayed on both molds and cores to prevent chemical reaction with the ingredients of the molding sand.

All heats are poured from small pots which hold 250 lb. of magnesium. This is necessary because of the narrow temperature range during which the metal can be poured. Pouring temperature is predetermined for each type of casting, and each mold is poured within the narrow range of 25 deg. F. There is one compensation, however. Any metal unpoured can be remelted along with all the sprues and other scrap, for the quality of the metal does not deteriorate with repeated melting.

Due to the high shrinkage of magnesium, variable sections are difficult to cast and hence cast iron chills are a very necessary adjunct of every mold. The chills must be light enough to stay in the sand in an inverted position and yet heavy enough to chill the hot metal properly. On account of its lightness, magnesium requires unusually large risers to feed all the intricate sections

ALL PHOTOS BY CHEVROLET DIV., GENERAL MOTORS

Fig. 4. After mold has been finished, drag is turned over on this machine and pattern lifted out of sand. Observe how loose pieces stay in sand of mold.

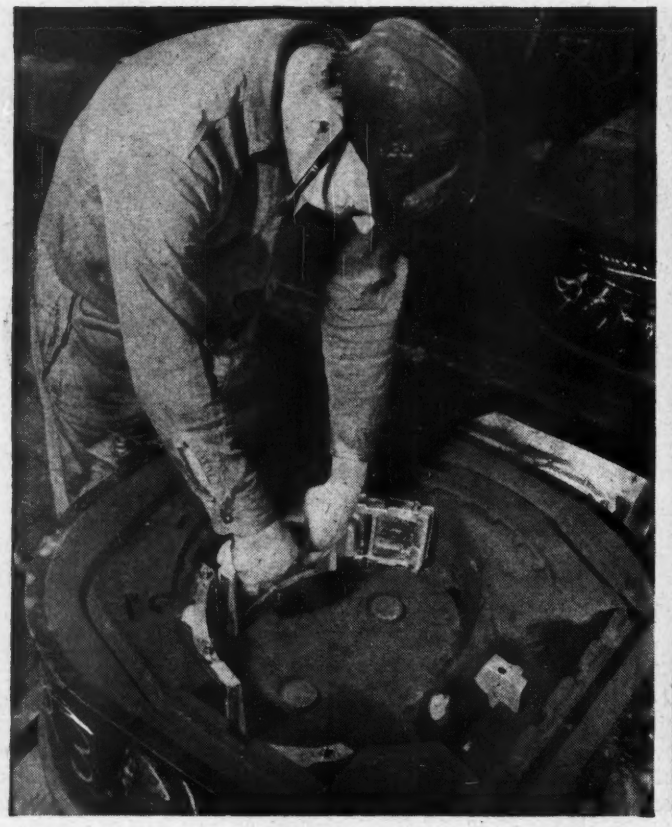


Fig. 5. Molder removing loose pattern pieces from finished mold. Note how smooth sand in all these molds remains after pattern is withdrawn. **Fig. 6.** (right): Same mold as Fig. 5 but with loose pattern pieces removed. Molder is "slicking up" a slight break in sand. Loose sand is removed with a vacuum tube instead of air pressure so as not to disturb surface finish of sand.

of the castings and to maintain the proper grain structure. Risers may weigh from two to four times the finished weight of the casting, but after careful cleaning they can be remelted with new metal and used over again.

All castings are made from 21-lb. "H" alloy magnesium ingots produced by the Dow Chemical Co. Castings made for the Chevrolet-built Pratt & Whitney engine include the blower housing, the impeller, the diffuser insert, different rear intermediate crankcases, and two rear crankcase sections. One of these is depicted here in the various stages of production.

Only metal patterns are used, and after the sand is rammed into the mold, patterns are withdrawn by mechanical means to prevent disturbing the sand and shifting the loose pieces. As many as 35 loose pieces are required for some

Fig. 7. Baked sand cores have to be set with unusual accuracy, since there is no leeway allowed in making airplane engine magnesium castings. Note metal frame used to guide and locate core which this molder is inserting. After it is in place he will take a wire with a $\frac{5}{32}$-in. ball on the end and check all around core to make sure spaces which control metal thickness are correct.

castings. To eliminate delays, as many as three complete sets of loose pieces are used with each pattern.

Completed molds are placed on a roller conveyor where the loose pattern pieces are removed and the cores set in place. After the cores are placed in the mold, they are checked with templates to insure proper location. When the drag, or bottom part of the mold, is finished it is covered with a sheet metal cover to protect it from dust and loose sand. The drag mold is then transferred to the power conveyor and moved to the point where the "cope", or top half, replaces the metal cover. The complete mold then moves on to the pouring station.

Magnesium comes to the foundry in 21-lb. ingots which are melted in 2,000-lb. oil-fired furnaces, heated to 1,250 deg. F. Reclaimed sprues and risers are melted with the virgin ingots. The molten metal is then transferred to a battery of oil-fired pots for superheating between 1,650 deg. and 1,700 deg. F. Each pot, which holds about 250 lb. of the superheated metal, becomes the pouring ladle after it is withdrawn from the furnace and brought to the pouring station at the mechanized conveyor line on overhead rails. Heat control is registered on a pyrometer thrust in the ladle, and pouring does not start until the temperature of the metal reaches a predetermined point.

Pouring temperature varies with different castings but averages around 1,350 deg. F. A special flux, or inhibitor, made by Dow and containing borax and sulphur, is shaken into the ladle while pouring to prevent ignition of the molten magnesium. Flux is also added during melting and superheating in order to refine and inhibit the metal.

After casting, cores are knocked out on a specially developed machine. A shot blast machine removes the remaining sand. Gates and risers are then sawed off and the castings are then acid-dipped, water-rinsed, and dipped in a dichromate solution. This treatment protects the surface from oxidation and discloses any defects when inspected. To speed up the preparation of the castings, a Davis miller, equipped with a four-place rotating fixture (formerly used for finishing cast iron cylinder blocks) has been converted into a continuous cutting saw which removes the sprues and risers from the castings.

Drill presses equipped with end mills smooth off the stubs left by the risers. The work then goes to the cleaning room where operators using pneumatic tools do the various jobs of burring and grinding to remove fins, seams, and parting lines. Women perform most of these finishing operations, working in booths from which the dust is drawn through wet dust arresters which deposit the fine particles of magnesium in a bath of water, thereby removing the dangers of any "mag-dust" explosion.

After finishing, castings are heat-treated. The first heat treatment is to relieve internal strains, and this is accomplished by routing the castings through a continuous oven on a conveyor system which works automatically. The oven is made up of compartments

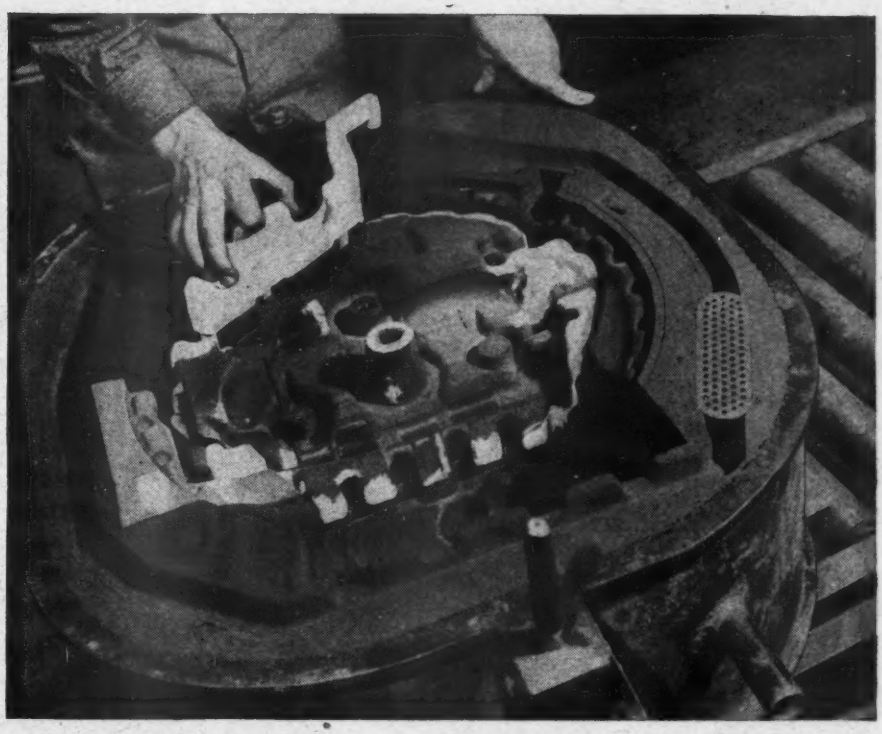


Fig. 8. Inserting interlocking cores that are guided by core prints. This is a very ticklish job, for a whole casting may be spoiled if a little sand is broken off and knocked into bottom of mold. At right is perforated strainer core through which all metal must flow. Beneath it is a pad of steel wool as a further precaution against loose sand or slag getting into mold while pouring.

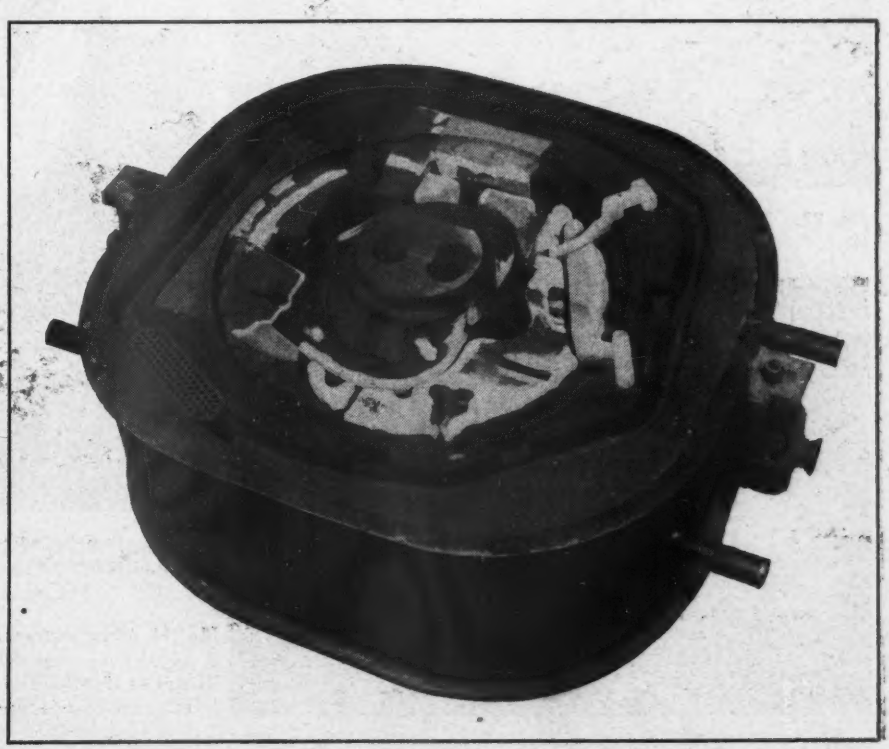


Fig. 9. Completed "drag", or bottom part of mold, ready to be inspected. All cores are in place. Drag only needs a "cope", or top part, to make it ready for pouring.

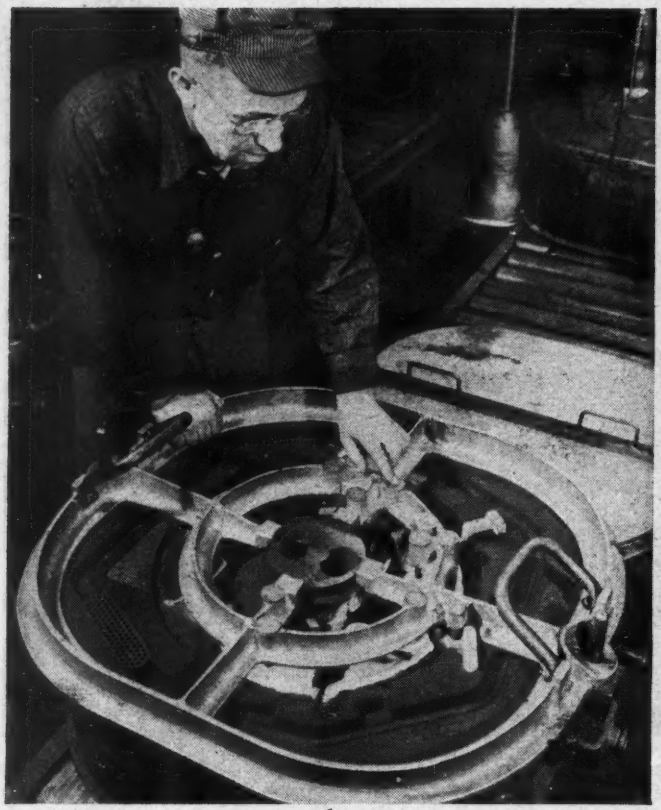


Fig. 10. Inspecting finished drag to make absolutely sure every core is exactly in proper place. With such fixtures as this, cores are set within 10/1,000 of an inch.

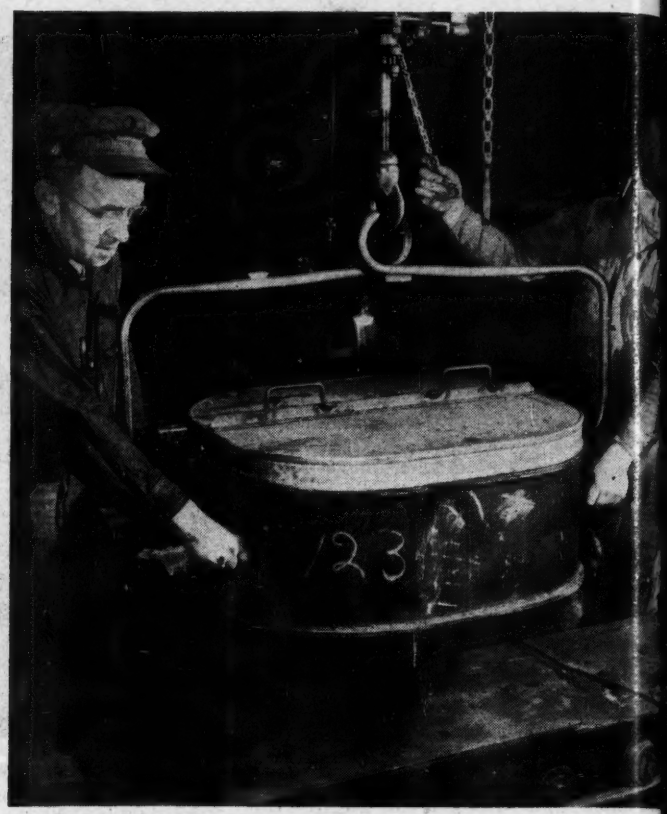


Fig. 11. As soon as a drag has been inspected, it is covered to prevent any dirt getting into it, then set on conveyor which takes it to cope installation point, where mold is closed.

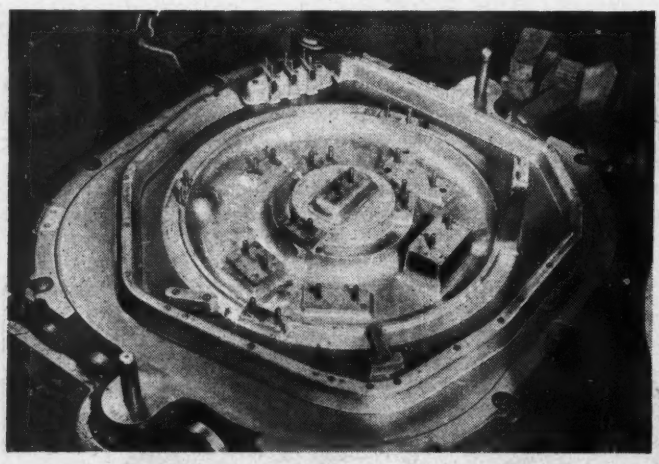


Fig. 12. This is cope pattern on which upper half of mold is made. Here, "risers" and "gate" have been removed.

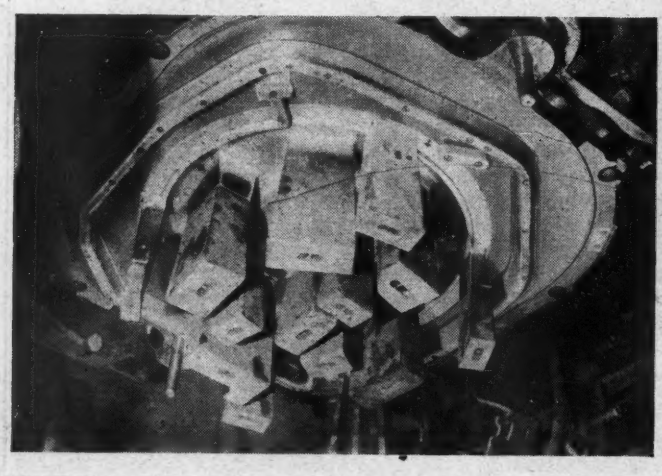


Fig. 13. Cope pattern with riser extensions in place. Note they are tapered opposite way from pattern. Therefore they have to be pulled out of sand with a hook before cope is turned over for removal of pattern.

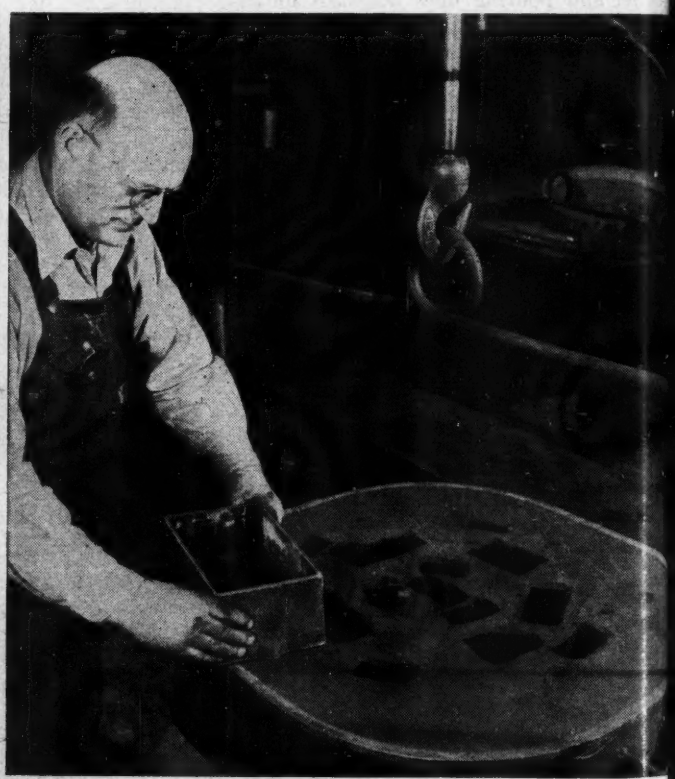


Fig. 14. Setting "runner box", through which magnesium is poured, on top of finished cope. It is now ready to be lowered onto drag.

The B.F. Goodrich Airline of the month

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Three screw sizes—complete range of grip lengths.

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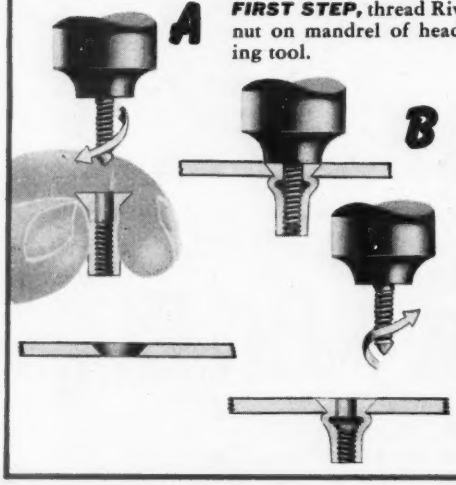

A ***FIRST STEP,*** thread Rivnut on mandrel of heading tool.

B ***PULLING UP*** with power or hand-operated tool upsets Rivnut on blind side.

C ***FINAL STEP,*** remove tool by unscrewing mandrel from upset Rivnut.

YES, YOU CAN GET RIVNUTS NOW! Facilities for manufacturing B. F. Goodrich Rivnuts have been greatly expanded to accommodate the growing needs of aeronautical and allied manufacturers. This added capacity should make it possible for us to fill all normal orders promptly.

That means you can plan now to use these unique blind rivets without reservation. Make the most of their time, labor, and money-saving advantages!

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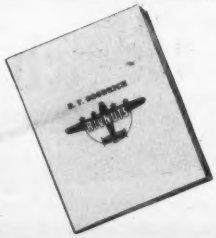


DATA BOOK... FREE! Contains information you'll want on Rivnut types, sizes, grip ranges, strength and weight. Get your free copy by writing (on letterhead, please) to The B.F.Goodrich Co., Aeronautical Division, Akron, Ohio.

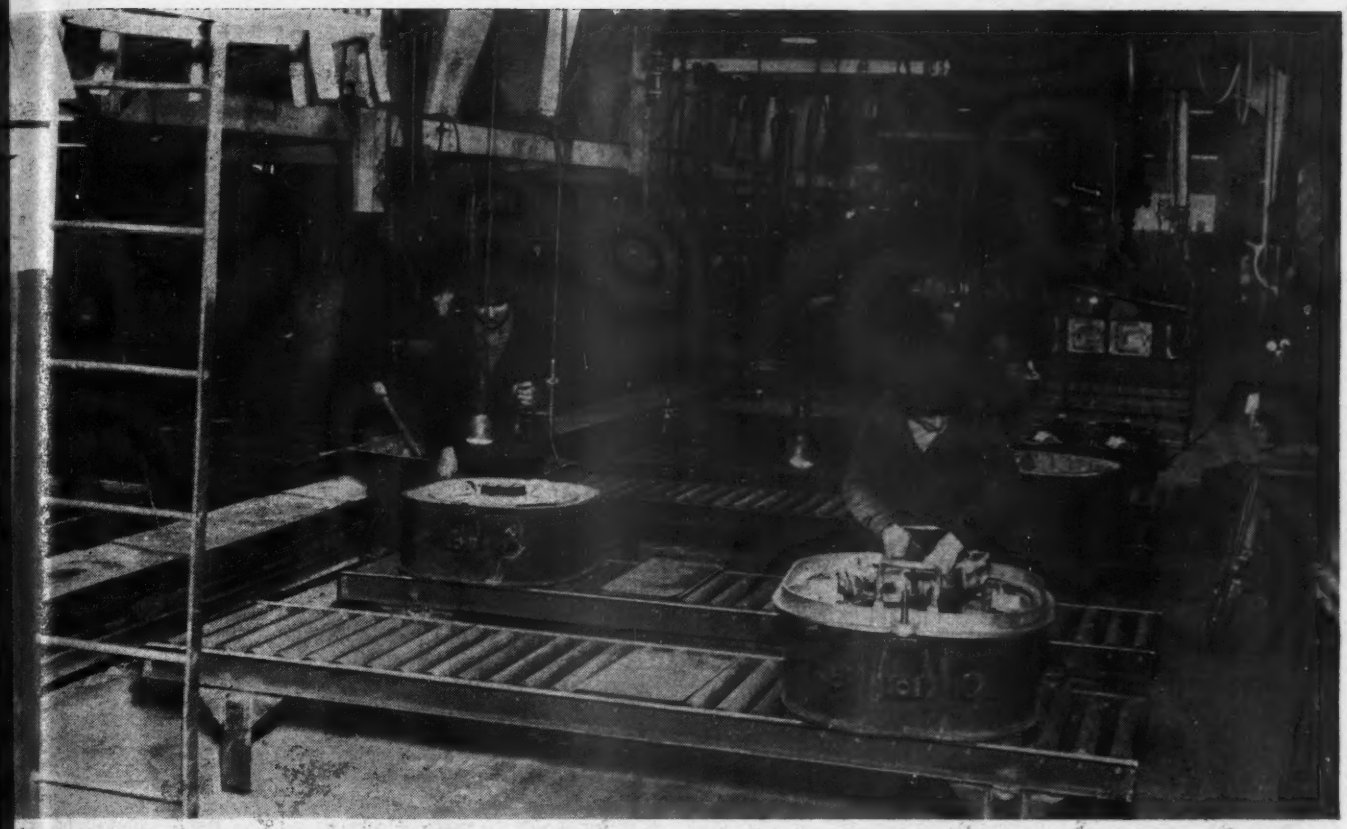


Fig. 15. Typical molding line in Chevrolet magnesium foundry, which is noteworthy for its cleanliness. A moving conveyor runs at left. Beyond, at far left, are drag molding machines. In foreground are transverse roller tables on which molds are placed for removing loose pieces, setting cores, and inspection. When complete, they are put on moving conveyor.

separated by doors which open at intervals of 2 hr. as the cars carrying the castings advance from one compartment to the next. As the castings move through the oven, they are heated first to 600 deg. F., then raised to 730 deg. F., where they are held for 12 hr. Castings are allowed to cool slowly to room temperature as they reach the last compartment.

There is also a battery of electrically heated rack-ovens, built by General Electric. Each oven is provided with 18 fans for circulating the heat evenly throughout the entire oven.

Aging takes place in another battery of rack-ovens formerly used for baking cores and now converted to this new use. Castings are aged at 350 deg. F. for 8 hr.

Visual inspection is aided by giving the castings an acid bath and rechromating after the heat treatment and aging treatment operations. Castings are also inspected on fixtures equipped with "target" gages which enable inspectors to check dimensions quickly and accurately. Intricately designed micrometer gages, capable of reaching otherwise inaccessible sections, are used in checking the wall thickness of the castings. Marked blueprints mounted above the inspection benches show the 30 or 40 points that have to be checked on each of the larger castings.

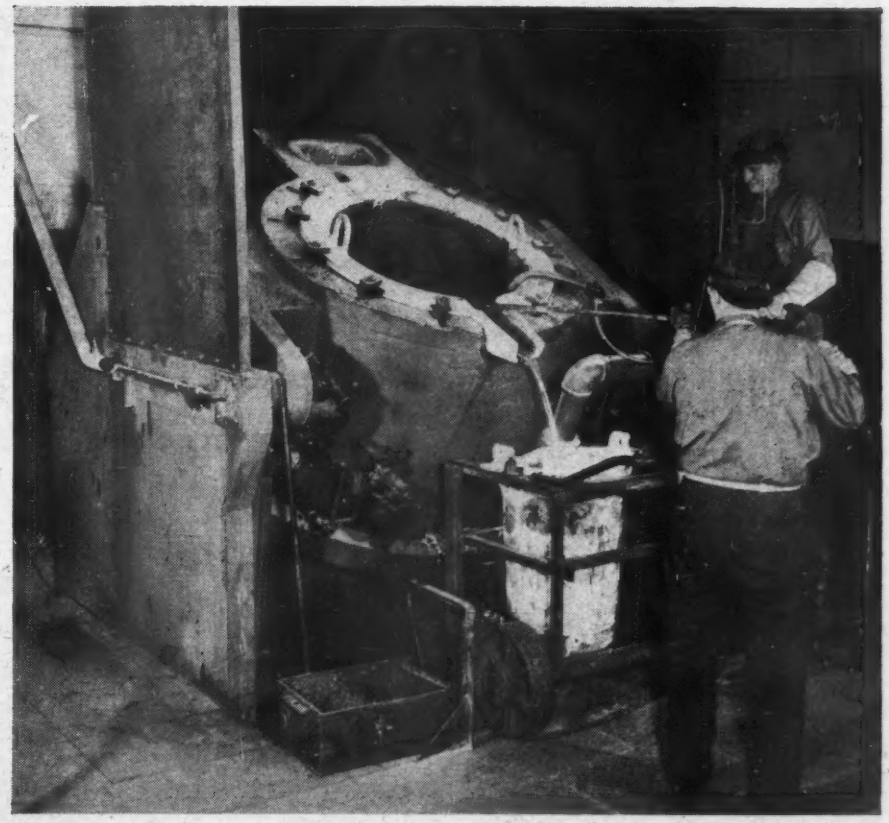


Fig. 16. This is 2,000-lb. capacity gas-fired ingot melting furnace. Virgin metal and sprues are melted up in this primary furnace, then metal is poured into smaller pots for superheating prior to pouring. Notice pyrometer lead at right side of pot. Temperatures must be accurately controlled.

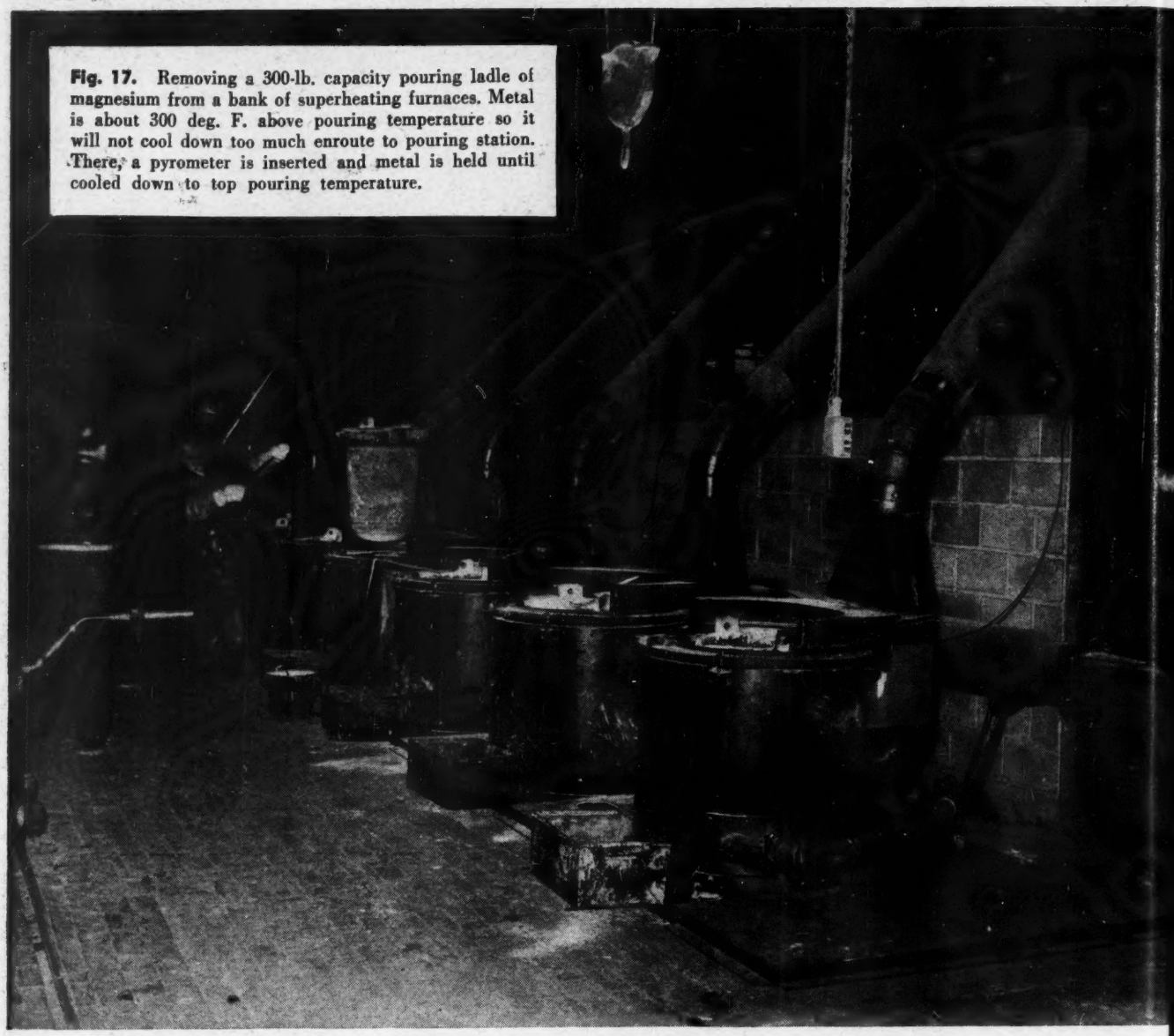


Fig. 17. Removing a 300-lb. capacity pouring ladle of magnesium from a bank of superheating furnaces. Metal is about 300 deg. F. above pouring temperature so it will not cool down too much enroute to pouring station. There, a pyrometer is inserted and metal is held until cooled down to top pouring temperature.

Fig. 18. Huge auto cylinder-block casting milling machine converted for removal of risers from magnesium crankcase parts. A saw instead of a mill is used on cutter spindle. There are five stations on milling table, giving operator time to change castings.

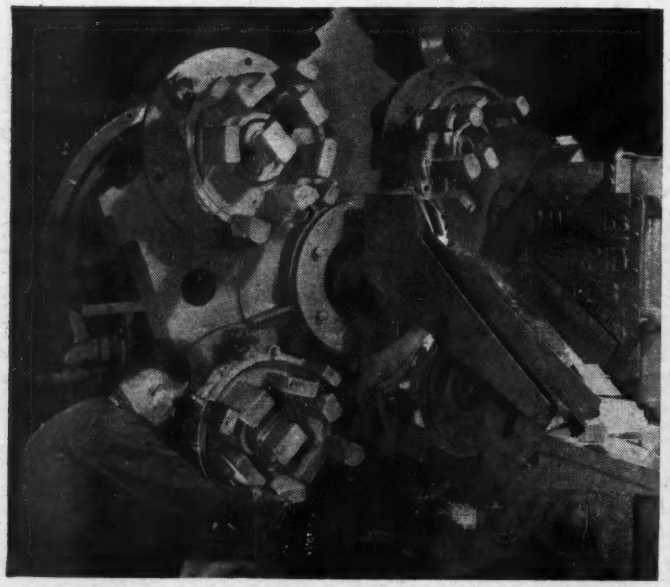


Fig. 19. Cleaning and protecting finished magnesium castings first bath, sulphuric acid quickly cleans casting. After washing is coated in a bath of dichromate, which protects casting from rosion and makes inspection easier because of its brown colora

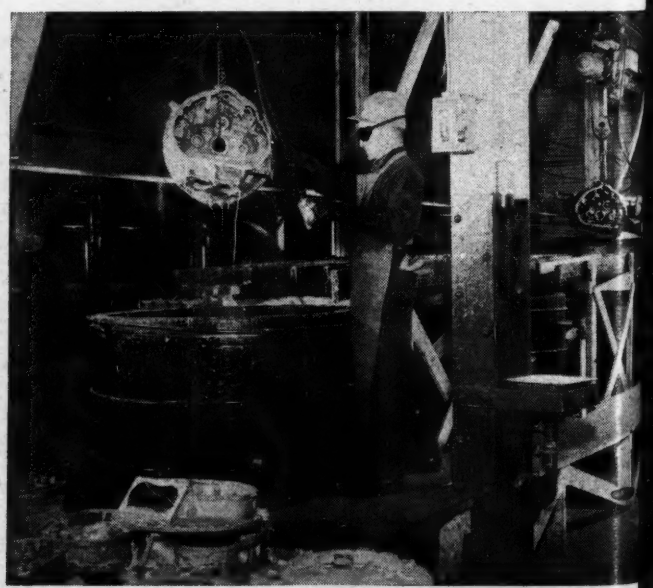


Fig. 20. A simple rugged fixture has been provided to mill off riser bosses that are below level of casting flange. A series of holes in table allow a capstan bar to be inserted to turn casting. Holes are placed where it is easiest for operator to handle. This gives a very rapid rotary feed. Down feed is also hand controlled.

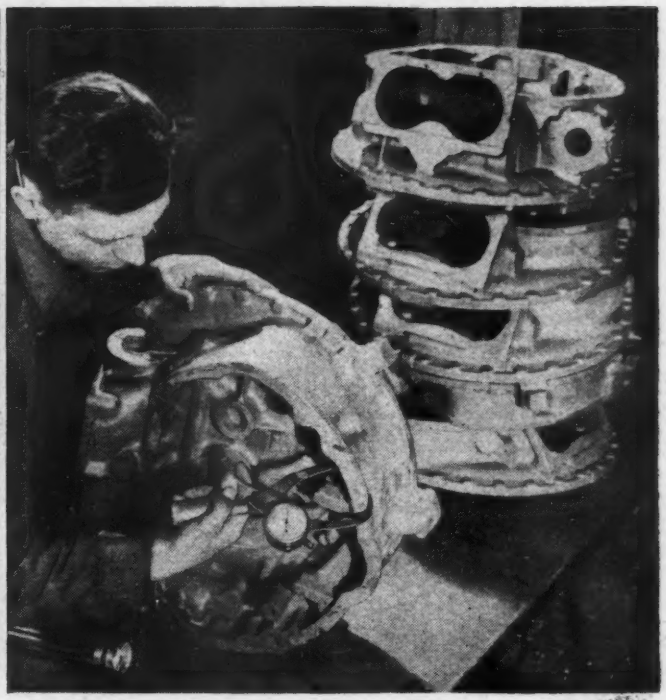


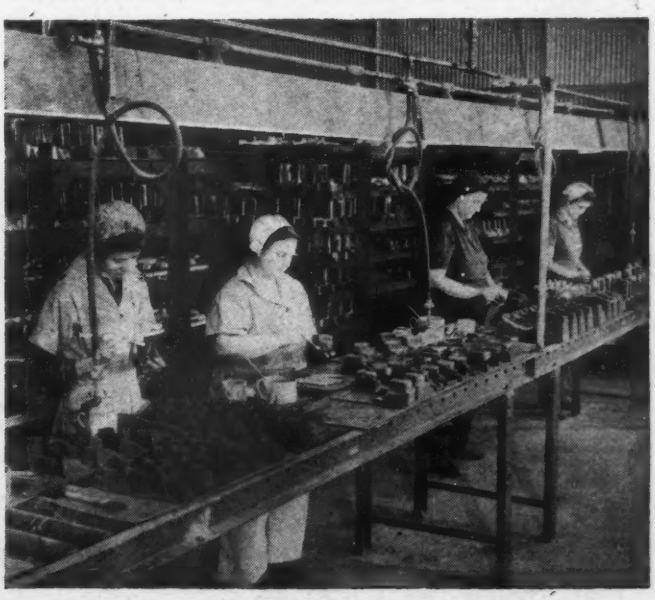
Fig. 21. Every wall thickness is carefully checked with calipers that read in thousandths of an inch. Sometimes as many as 35 different places are checked on a single casting. Often half a dozen different shaped calipers are required to measure one casting.

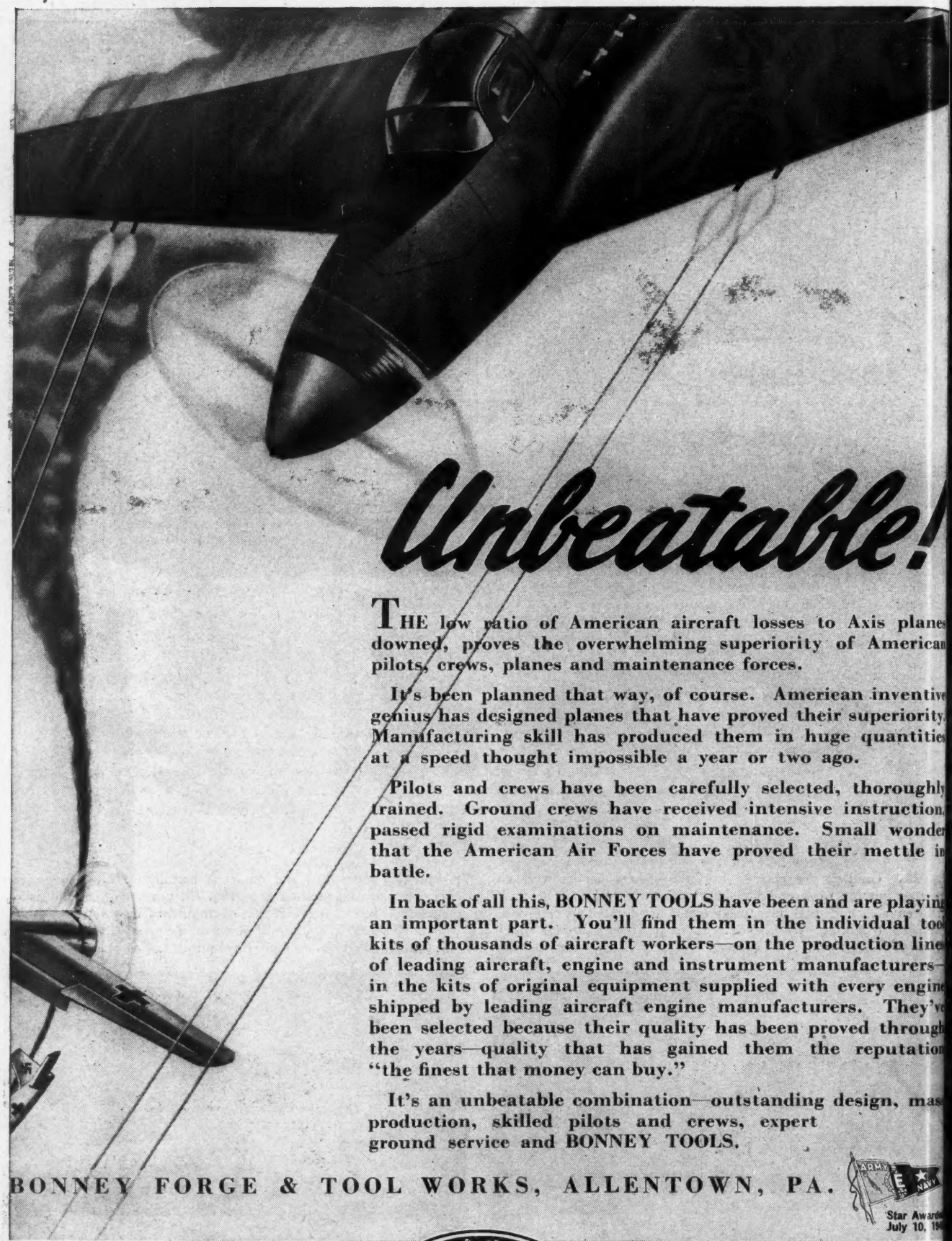
All castings that have oil passages are pressure-tested in order that any leakage may be detected. Prior to shipping, oil passages are sealed by a process of impregnation with special drying oil or a sodium silicate solution.

The most important differences observed between making aircraft magnesium castings and automotive iron castings is in the unusual care and accuracy with which the cores and molds for magnesium have to be made, the careful control of pouring temperatures, and the more extensive heat treatment of the castings.

Due to the greater porosity and shrinkage of magnesium, and also the exacting standards established for aircraft construction, Chevrolet foundrymen had to work out several new applications of processes formerly applied to gray iron in order to deal with the problems, which varied with each type of magnesium casting produced.

Fig. 22. Castings are cleaned in these special booths with air operated burring tools and polishing wheels. Interior of booth is white enamel, and dual fluorescent lamps are located in ceiling to give perfect lighting. Workbench is made up of slats through which all abrasive dust and grit is drawn by vacuum. A water bath is provided to settle dust and render it harmless. This also protects operators from magnesium fires. **Fig. 23.** Core room is kept as immaculate as rest of foundry. It is distinguished by number of women who work there. They are of practical housewife type. Cores are carefully handled on cushion pads laid on top of steel plates.





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Spotwelding Expedites Lockheed "Constellations"

By **ELLIS F. GARDNER,**
Project Production Engineer, Lockheed Aircraft Corp.

Research program reveals both design and production advantages via technique heretofore limited almost entirely to non-structural members.

WHILE the Lockheed *Constellation* was still in the idea stage, our engineering management saw the possibilities of utilizing the inherent properties of spotwelding in primary structural design. Prior to this time it had been used mostly for cowl panels, inspection doors, nacelle doors, equipment brackets, and other places where possible failure of the parts normally would not constitute a hazard to the safety of the airplane. Even these non-structural or semi-structural applications were very limited in scope.

At Lockheed, resistance welding, such as single spot, roll spot, and seam or overlapping spot, is not confined to the *Constellation* airplane. However, the varied and extensive application of these forms of sheet metal joining on this particular airplane indicates some of its uses as a design and production expedient.

Fig. 2. Inspectress making one of numerous X-ray tests to assure high quality welds. She keeps constant check of strength values of welds being made on several machines simultaneously.

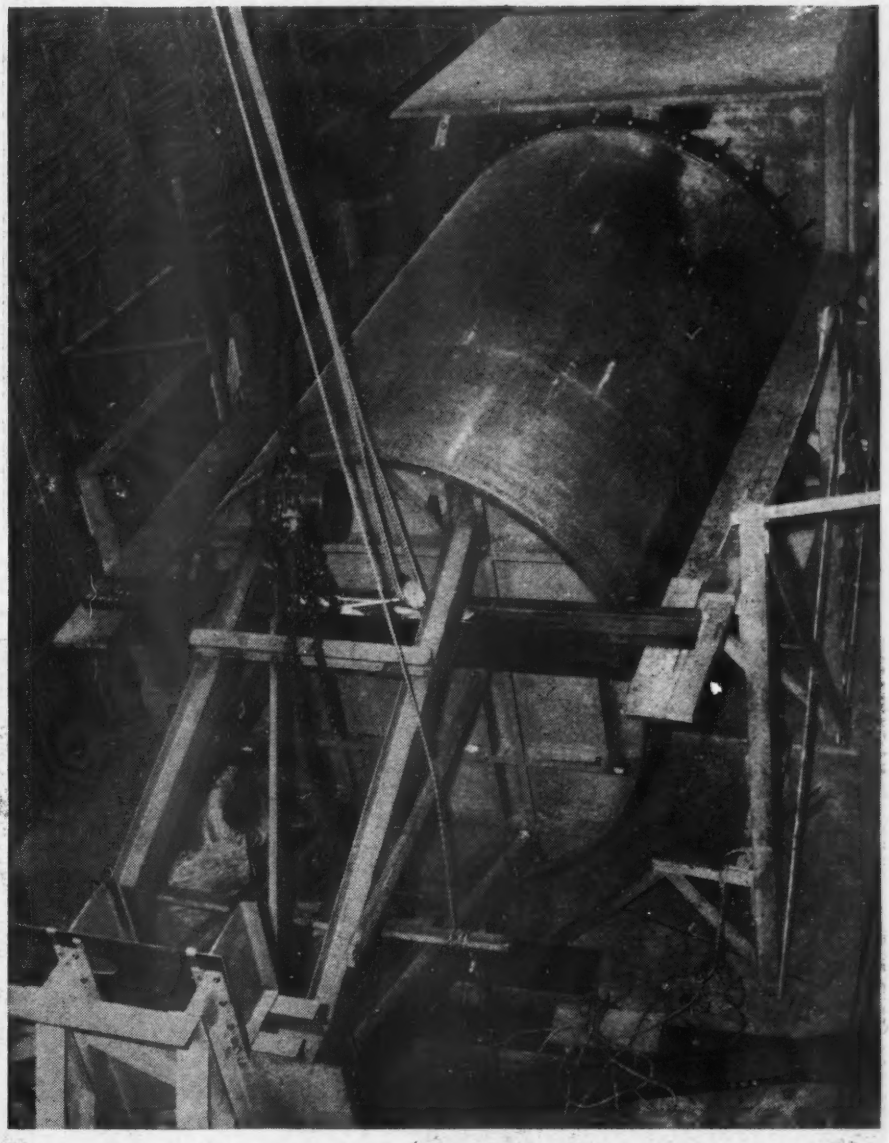


Fig. 1. Testing program on this section of Lockheed *Constellation*, using riveted and spotwelded construction, began in 1940. Integral with foundation set 12 ft. below floor, steel reinforced concrete blockhouse in background held far end rigid. Arc welded framework in foreground was capable of loading section in bending, compression, tension, and torsion or rotation. In addition, internal pressures were applied to simulate high altitude conditions.

In 1940, a large partly riveted and partly spotwelded section of a proposed fuselage, 11 ft. in diameter and 17½ ft. long, was set up in the research portion of what was then the experimental department. This section, as shown in Fig. 1, was attached to a special reinforced concrete blockhouse at one end, and both ends were sealed. Various mechanical devices were constructed to check the structural properties, and a pump was installed to test the section as a supercharged fuselage simulating high altitude flying. The testing program verified that if forms of spot welding were used to preassemble the stringers to skin panels, then—

1. The various production and tooling problems could be simplified, and those involved in drilling, countersinking, or dimpling and riveting could be confined to the joints between the skins.

2. Elimination of the through rivet holes by substituting the welded areas would simplify the problems of pressure sealing.

3. With proper quality control and some improvement in the welding machines, improved strength, smooth aerodynamic surface, and decreased weight

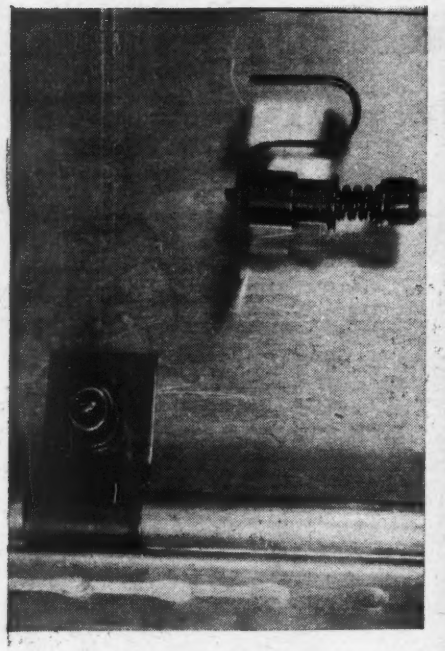


Fig. 3. Close-up of sheet steel clamp used for holding stringers. Note that clamp permits access so that roll welding may be done in single pass from end to end. Strips between weld buttons are typical roll welding. They neither add to, nor subtract from, strength of weld.

Fig. 4. Contoured fuselage panel, showi sheet clamps holding stringers for weldi

of skin panels could also be realize

Several methods of quality contr were tried before adoption of that us at present. It includes standardizati of machines and set-ups, plus a perio check of machine settings by the use standard pull tests on sample strip These samples are pulled apart as show in Fig. 2, and the strength of the we is determined and compared against standard minimum value which has be established for the different gage co binations.

In the early stages of developme the first machines used at Lockheed we relatively slow, required excessive mai tenance, and lacked sequencing contr Since then, however, improvements design, workmanship, and materi have been made. And the improv machines, coupled with quality contr good shop conditions, and adequate to ing, have brought the investigation the laboratory to a reality.

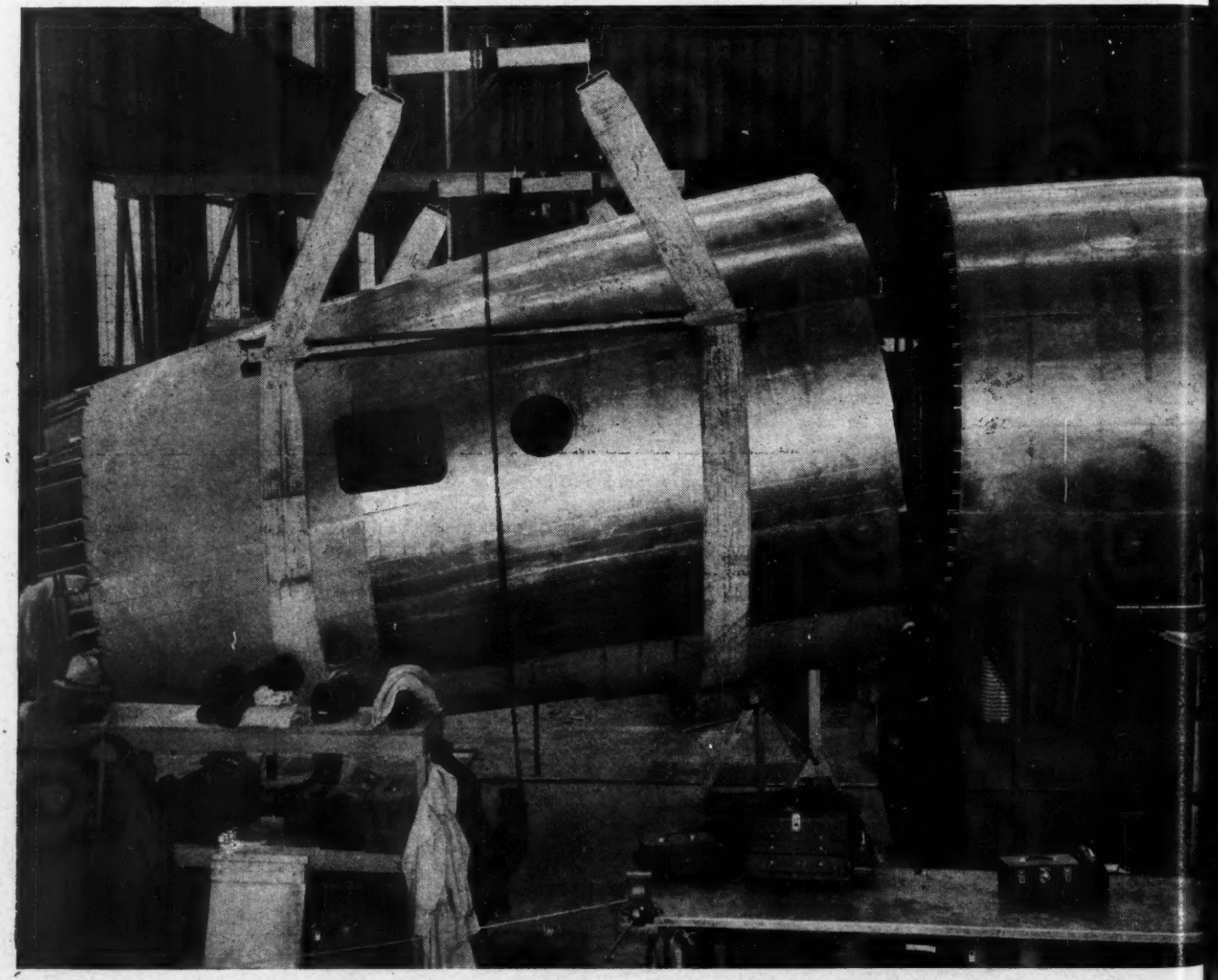


Fig. 5. Joining of two fuselage sections of one of first *Constellations.* Roll welded stringer panel assemblies are brought into place and riveted to bulkheads and other panel assemblies prior to mating operation.

In addition to the fuselage panels, other structural applications of spotwelding have been found for the *Constellation*. It is used extensively on outer wing panel assemblies, and stub and inner wing beam webs—comprised in some cases of heavy (.081) hat sections welded to heavier (.125) web sheets. The spotwelding on the power plants is particularly interesting and will be discussed in detail later.

Spotwelding of doublers to skins is often used in the airplane to structural and production advantages. However, discretion is required in utilizing less than approximately 24 spots. Unless design or manufacturing problems may be solved effectively by no other means, riveting is more economical than spotwelding where the number of attachments is small. There are additional maxims which apply for good service and production design using spotwelding, but before actual manufacturing economies can result, the shop sequences and tools must also be developed specifically for spotwelding.

In developing the *Constellation*, blueprints of the contoured skin and stringer combinations found throughout the plane were released to the manufacturing division and a development program was inaugurated. The results of this program form the bases for utilizing spotweld design. Tooling is necessary to position the stringers and maintain contour before welding. There is no tooling during the welding operation, except for use of simple sheet spring clamps developed in our shop. These clamps, shown in Fig. 3, are held in place by standard Cleco fasteners through holes in the skin at the side of the J-section stringers, and they curl up over the stringers to hold them in position. Thus they allow access for the spotweld rolls, yet no slippage or loss of contour is experienced during the welding of these panels (see Figs. 4 and 5).

Fig. 6. Roll spotwelding wing skin panel. Note that stringers are flattened in region where ribs will attach. This permits rib to have continuous attaching flange and improves production access.

In some few cases, panel assemblies will not support their own weight due to cutouts for doors, windows, and access panels. It is necessary, then, to provide longitudinally contoured "2x 4's" to give the assembly local rigidity during the actual welding operation.

The majority of the panel assemblies have relatively long, straight stringers and stiffeners and are particularly adapted to either of the two fastest production methods of attachment—spotwelding or automatic riveting. Using a 450 kva. roll welding machine, from 4,000 to 7,000 spots may be made in an hour, depending on the thickness of the aluminum alloy sheets to be welded.

Cost comparisons were made between riveted and spotwelded panels, and although the tooling and preparatory costs are practically the same, a 47 percent saving is realized in the joining operation by roll spotwelding in place of automatic riveting (see Figs. 6 and 7).

In the design of an airplane, one problem (which is becoming more important) is caused by the increased

Fig. 7. Single spotwelding of corrugated section. Although roll welding is used for most part, tack welding and pick-up work are sometimes necessary.

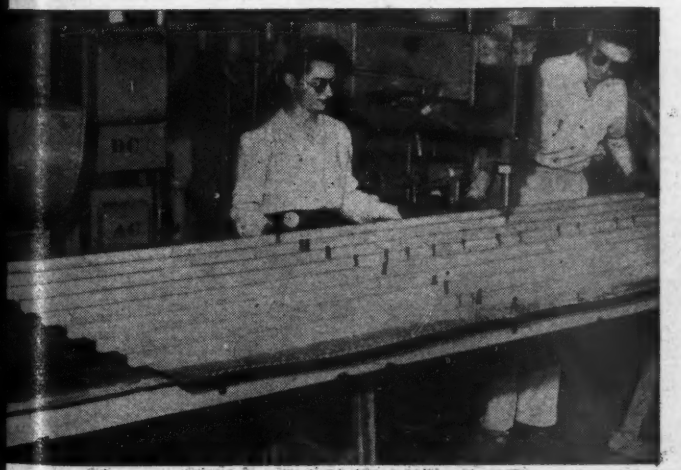


Fig. 8. Spotwelding rolled sheet section to make tube. Clamp around tube near electrode prevents distortion and helps maintain uniform diameter of tube.

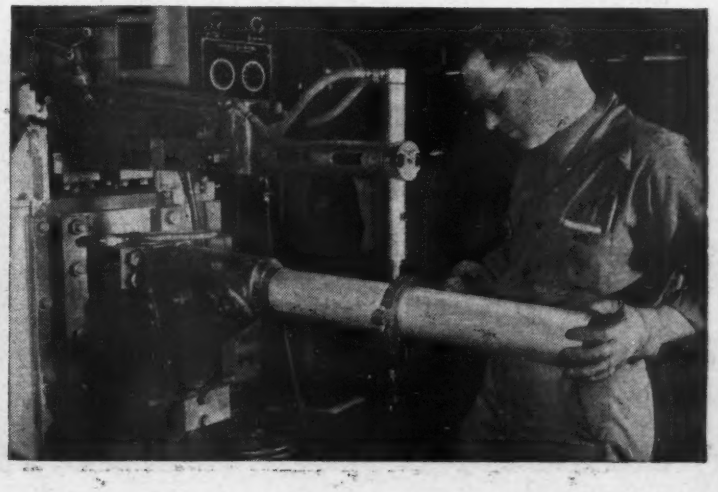


Fig. 9. Bending operation for rolled sheet tubing on standard tubing bender. In this case, angle is 90 deg. However, bend angle may be less or even more (up to 180 deg.) if there are applications for bends greater than 90 deg. on *Constellation*.

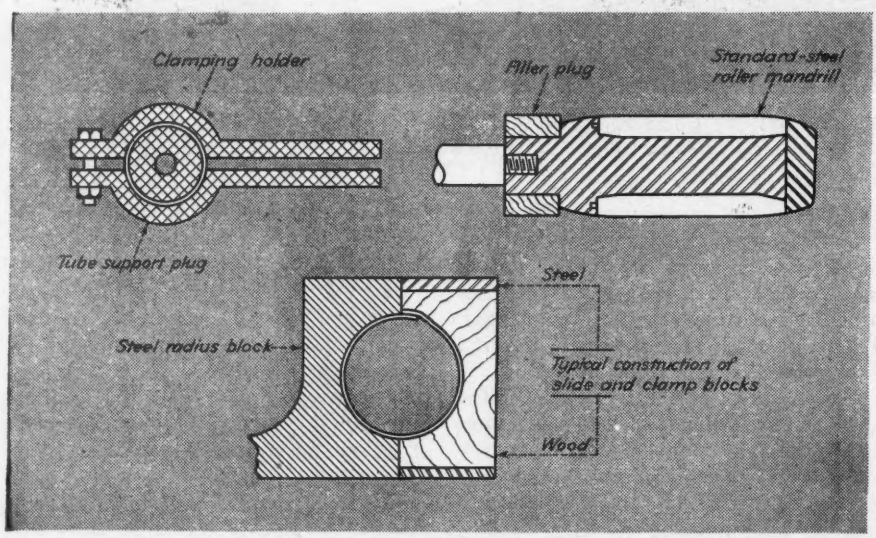


Fig. 10. Selections of tools used in manufacture of rolled sheet tubing. Roller mandrel fits inside tube to maintain its diameter during bending operation.

heating, ventilating, and other ducting used in high altitude aircraft. A noticeable percentage of the possible payload weight of the airplane is devoted to these items. On the *Constellation* it was found that with careful set-up in the shop, extremely light aluminum sheet (.010) could be rolled into straight ducts of regular cross-section, lapped and spotwelded longitudinally. However, shop handling of such thin ducts, and the special techniques required in welding, makes the use of .016 or heavier sheet a better criterion for design. Even then, however, the weight will be much less than the lightest extruded or drawn tubing.

Recently, in the interest of standardization, the WPB issued an order limiting the diameters and wall thicknesses of extruded and drawn tubes. In addition to the ducting just mentioned, it affected a large portion of the circular section elbows of 2½-in.-and-over diameters. Tooling was developed, on suggestions of the writer, for a method of bending 3SO rolled sheet, longitudinally spotwelded, on standard tubing benders to simulate the tubing which was no longer available. Sheet thicknesses of .025 and .032 were found most successful, and 90 deg. bends have so far been made up to 3¾-in. dia. on an 11¼-in. bend radius as illustrated in Figs. 8, 9, 10, and 11. Two requirements for utilizing this method are—

1. The longitudinal lap should be kept very close to, and slightly above, the neutral axis of the bend to prevent the spots from breaking loose due to the shear differential set up by the bending.

2. Design should incorporate a joggle at the longitudinal lap, and a recess should be provided in the tubing bend block to allow a roller mandrel to rotate inside the tube without interference during the bending operation.

Another application for spotwelding is found in ducting of irregular cross section—ducting whose components in-

Fig. 11. Test parts with uniform grid lines marked to indicate distribution of loads and plastic flow of material as result of bending.

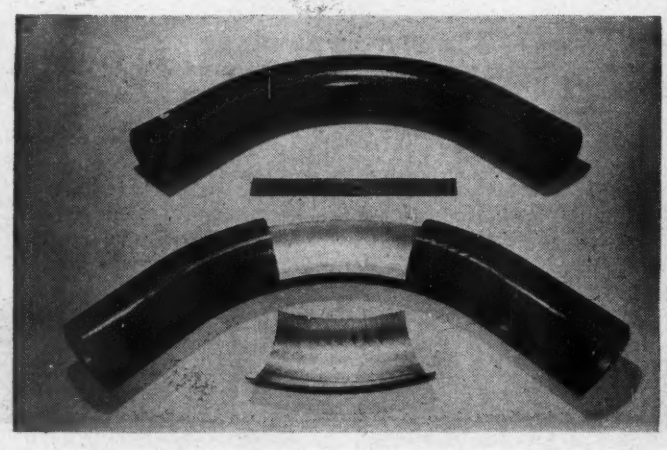
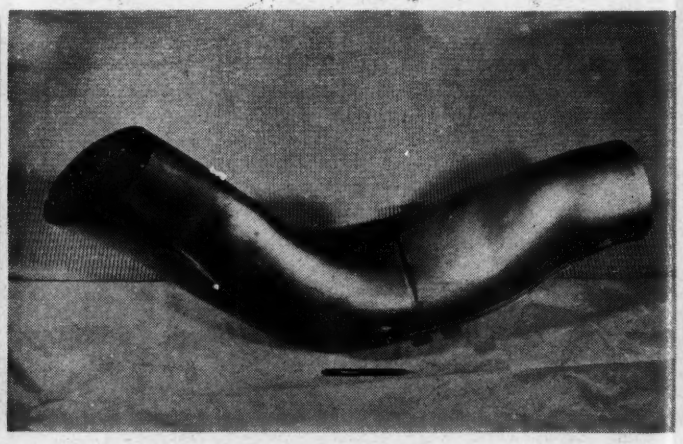
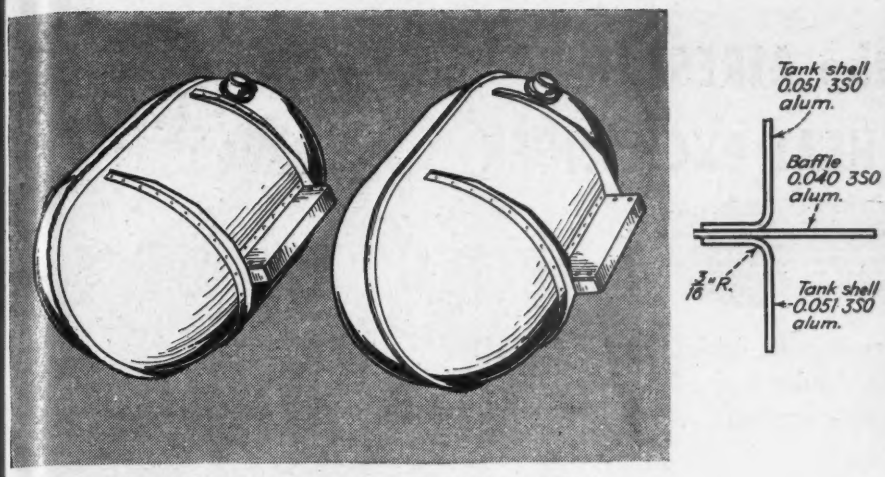


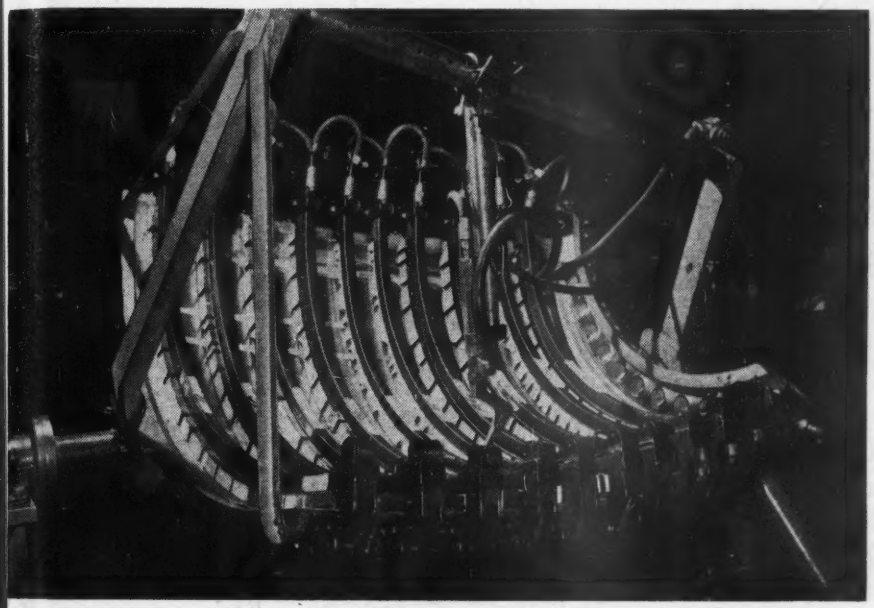
Fig. 12. Steel duct showing combination of seamwelding flanges and torch welding ends where mating with next section requires a somewhat flush finish.





Gas Welded Tank Roll Welded Tank

Fig. 13. Two tanks before testing and failure of torch welded version. Tank at left is torch welded, other is seamwelded. In both cases spotwelding was utilized to attach support brackets. Sketch shows cross section through standing flange before seamwelding.



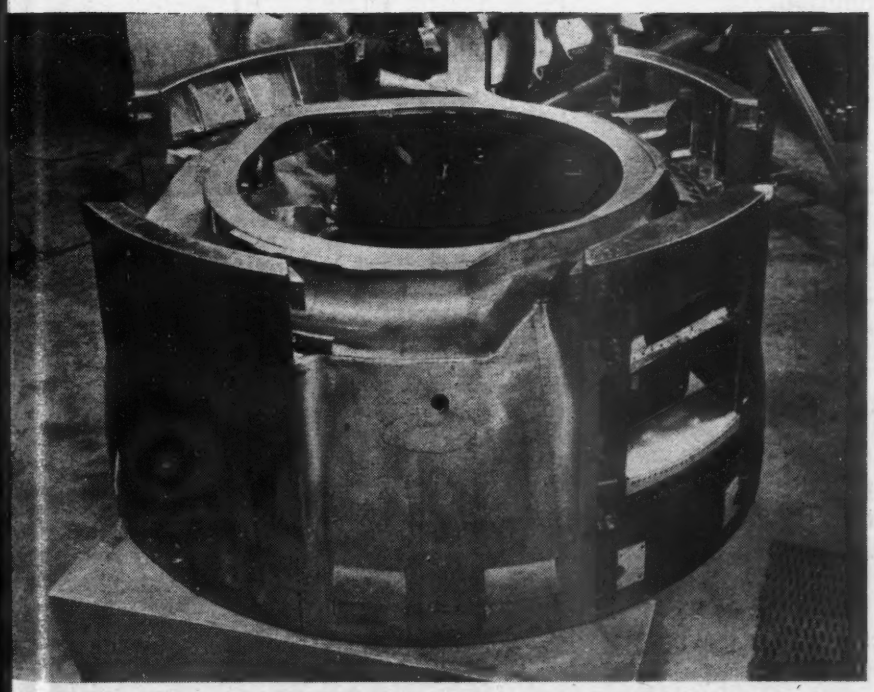


Fig. 14. Heat and corrosion resistant steel cowl panel, showing spotwelds and inner frame sub-structure.

Fig. 15. Panel similar to that in Fig. 14 in trunion fixture made up for portable spotwelding. Air clamps are utilized in positive rapid positioning for welding with portable head, shown in center.

volve compound forming and are usually made on the drop hammer from 52S or 3S aluminum alloys. Joining of these components previously was done entirely by torch welding, with its subsequent low production rate even though skilled labor is used. After careful cost analysis it was determined that, if more than 30 in. of standing flange could be allowed for roll seam welding, it would be economical in most cases to use both methods—roll seam welding the flanges and torch welding the ends where attachment to the next section of duct requires a flush surface.

Nor is this method of assembly confined to aluminum alloys. On another Lockheed airplane, SAE 1010 steel of a light gage is used in a simliar manner, as exemplified in Fig. 12.

Tanks subjected to high operating and higher testing pressures in the range of 50 psi. have presented difficult design and production problems to most aircraft companies. Tests were conducted at Lockheed on a tank comprised of two 3SO formed shells and a baffle which was torch welded to the standing flanges of these drawn halves. The tank failed at a considerably lower pressure than a seam welded version which withstood pressures up to 65 psi., and even then it did not fail in the weld.

(*Turn to page* 363)

Fig. 16. Power plant structure assembly after spotwelding. Assembly of corrosion resistant steel, such as this, would be very difficult to rivet, but is quite easily spotwelded.

facts about the AIRESEARCH EXHAUST HEAT EXCHANGER

WHY IT WAS NEEDED: U. S. engineers, designing warplanes for operation in higher altitudes and colder climates, called for a new heat supply system . . . one that required no auxiliary power.

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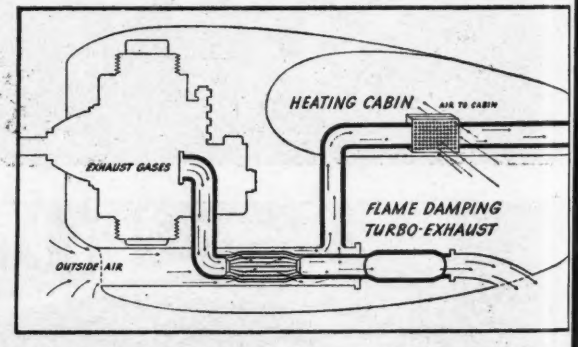
It proved successful. Flight tested in the severest Alaskan weather, the new *AiResearch Exhaust Heat Exchanger* met every qualification—and more!

WHAT IT DOES: As shown here, the AiResearch system ducts air from atmosphere over an exchange unit where it takes on heat from the exhaust gases.

This air then passes through a heater...warms air that is counter-passing into the cabin. Thus it eliminates danger of carbon monoxide contamination.

In addition to *cabin heating,* the AiResearch Exhaust Heat Exchanger acts as a *flame damper.* Here, air passing over the unit *cools* the exhaust gases to a degree where they will not ignite after leaving the turbo.



SPECIAL ADVANTAGES:

Lightweight, this Exhaust Heat Exchanger weighs little more than the section of exhaust pipe it replaces.

Complete in itself, the unit needs no auxiliary equipment...is practically invulnerable to mechanical failure.

Low back-pressure. It can be kept in constant operation with little or no drain on engine power.

Adaptable to all types and designs of aircraft. And can be used for cabin heating, flame-damping or both.

ARMY (E) NAVY

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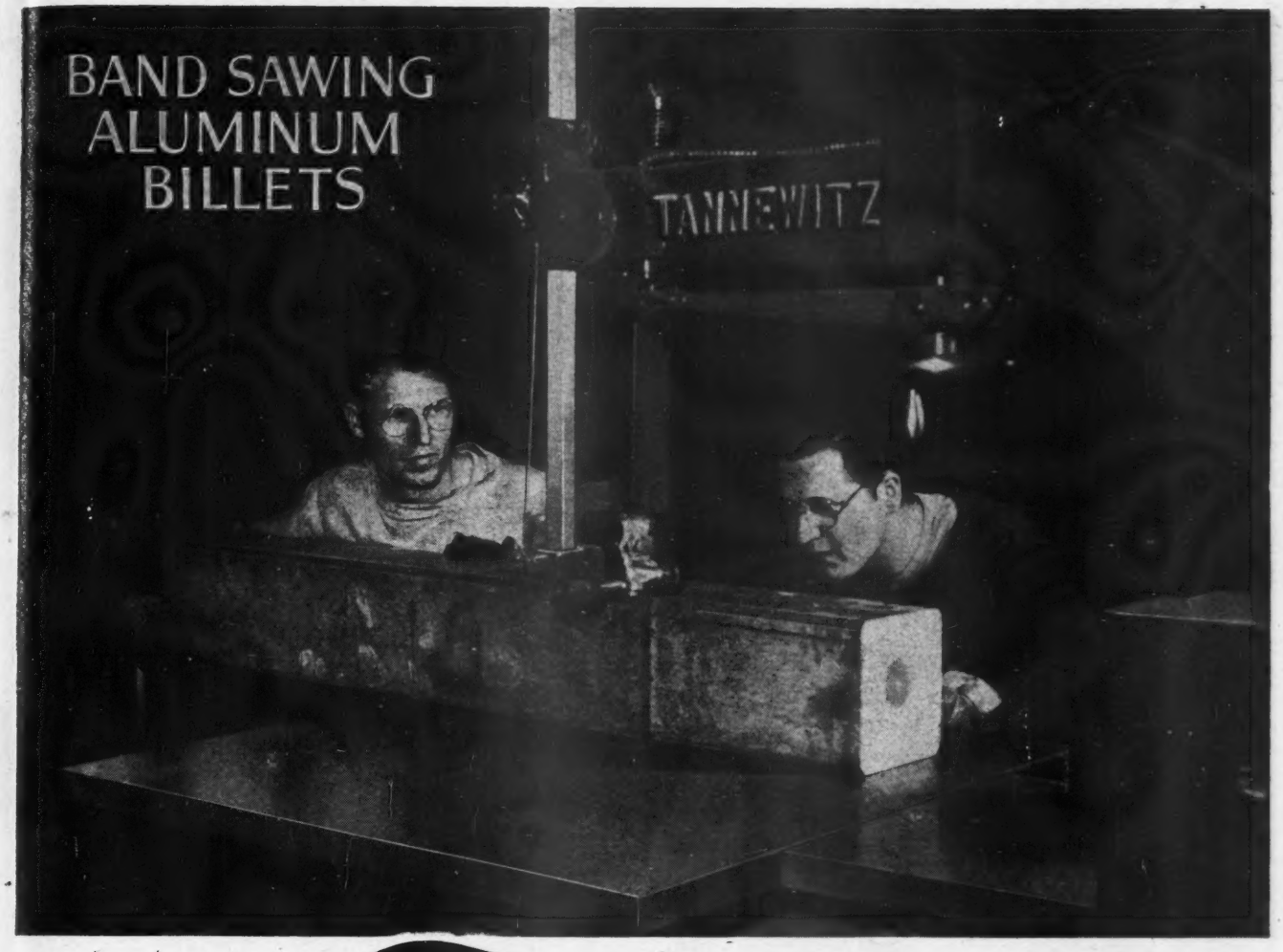

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DALLAS, TEXAS

Pressure Control In Aircraft Hydraulic Systems

Part I

By EDWARD M. GREER, *Pres. and Chief Engineer, Greer Hydraulics, Inc.*
and LIEUT. COMDR. HARRY J. MARX, USNR,
In Charge of Hydraulics, Bureau of Aeronautics, USN

With higher and higher pressures being used in modern aircraft hydraulic systems, accurate and positive control is essential. In this series, the problems of control are discussed and the various control devices are described. Relief valves ar initially covered.

PREVIOUS TO THE PRESENT WAR, hydraulic actuation in aircraft was confined largely to raising and lowering landing gear and the operation of wing flaps. Only one or two companies in this country had any experience with the use of hydraulic systems in aircraft or were doing very much research or development on the subject. However, it was generally recognized that through hydraulic actuation many cumbersome and intricate jobs could be done.

Although one large American airplane manufacturer was doing extensive research and development in this field and greatly expanding the use of hydraulic equipment, very little thought was given to the control of pressure, beyond that of preventing the pressures from building up beyond the bursting strength of the hydraulic system. The control of fluid flow was limited to the selection of the hydraulic device to be operated and the direction of its operation. Even today we see that, when the landing gear is retracted on the airliners made available before the war, one wheel goes up first and the other follows at various rates of speed. This, of course, puts a side load on the airplane during takeoff—a load which must be compensated by the flight controls. One wheel rises before the other because of unequal loads presented to the hydraulic actuating unit due (1) to greater friction in one landing gear component over the other, (2) unequal wind loads during takeoff, or (3) unequal friction in the hydraulic actuating cylinders themselves. Thus, when hydraulic power is supplied to the landing gear, the flow of oil follows the course of least resistance, raising one wheel before the other. Inasmuch as it is necessary that wing flaps be lowered or raised together, it was the practice to employ a single hydraulic actuating cylinder to operate two flaps by mechanical linkage. Most common of these mechanisms is a series of cables and pulleys connected to the flap cylinder and to the wing flap.

It must be realized that the above type of operation is satisfactory in commercial airplanes, whose speeds during takeoff or landing (at which time landing gear or flaps are actuated) are in the neighborhood of 100 mph. In modern military aircraft, however, these operations take place at much higher speeds and much finer control of actuation must take place. The fact is that at these higher speeds—especially with use of dive flaps in dive bombers—the loads induced become so large that the whole problem of pressure and flow control becomes greatly magnified. The problem is further complicated with addition of landing gear doors which completely enclose the landing gear after retraction and must be timed to open and close in sequence with the landing gear.

The modern military airplane employs, in addition to landing gear and flaps, a great deal of hydraulically operated devices, among which are bomb doors, hand release mechanisms, bomb loading hoists, antenna retracting mechanisms, and machine gun and cannon chargers. The modern gun turret has its own hydraulic system to control rotation as well as angular position. Fineness in control in this unit is the most sensitive function that hydraulic operation is required to perform. The larger cargo airplanes call on hydraulic

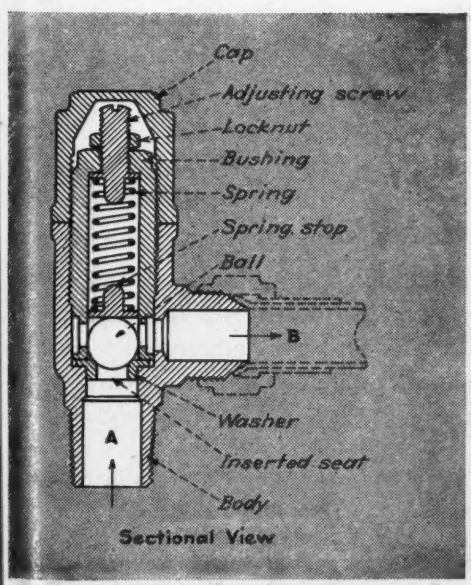


Fig. 1. Early, ball type relief valve.

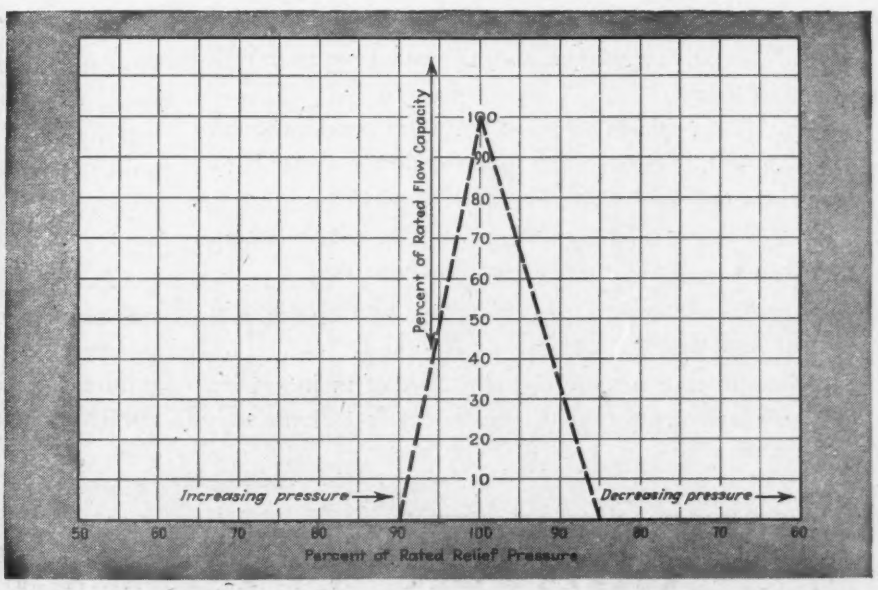
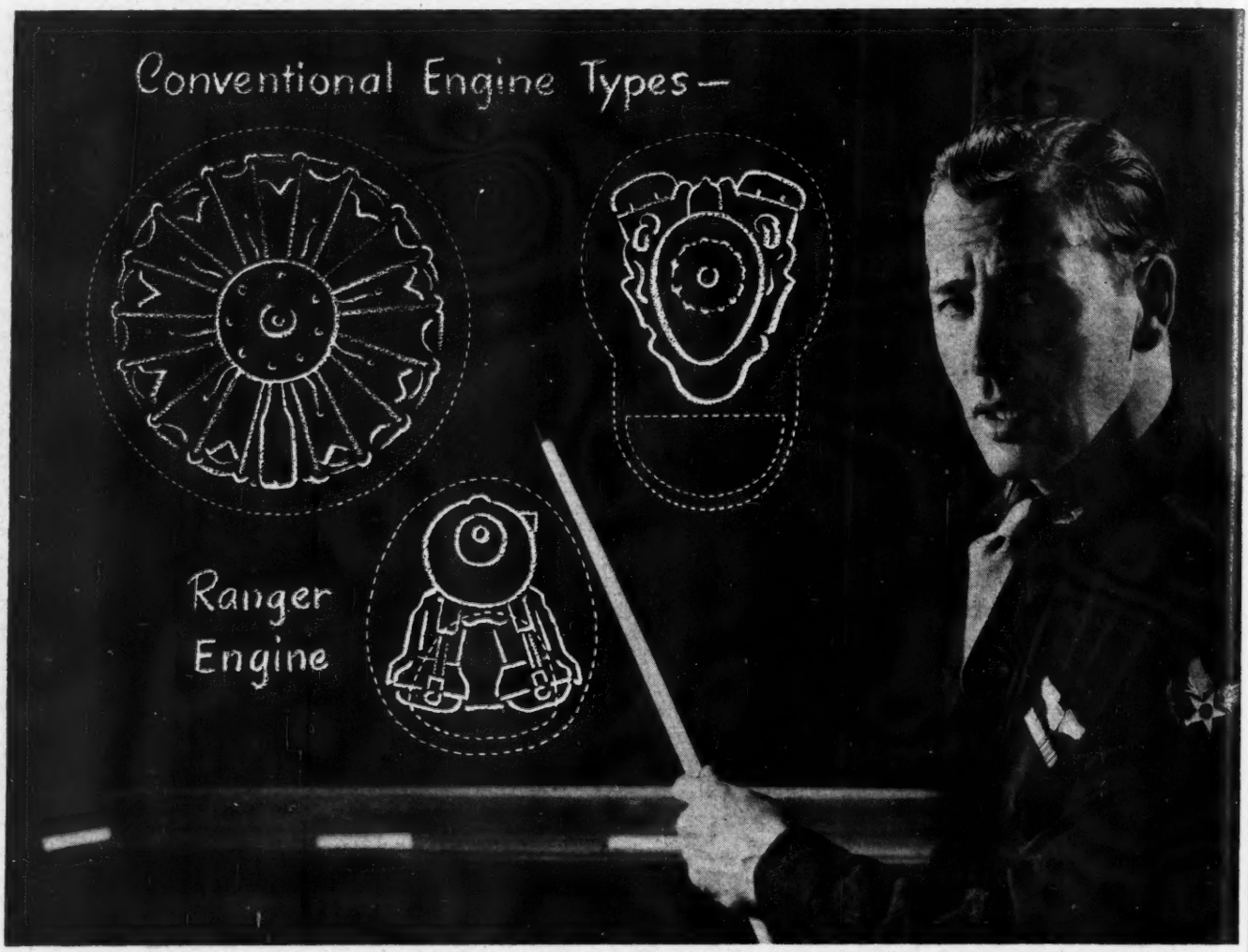


Fig. 2. Allowable leakage and flow curve for AN standard hydraulic relief valves.

POINTERS ON ENGINES . . . . . *No. 1 of a Series*



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3. Simplify the usually complex task of maintenance and daily inspection (a vital safety factor) through easier access to the power plant of the airplane.

That the Ranger Engine fills the bill on these 3 vital counts . . . and on others, too . . . is attested by the fact that the U. S. Army Air Forces have chosen Ranger-powered planes, the famous Fairchild PT-19's and AT-21's, for the task of training quickly thousands of pilots and aerial gunners.

When Fairchild engineers turned aircraft engines upside down and produced the Ranger, they did it with an eye to safer, speedier, more efficient sky travel—another example of Fairchild's "touch of tomorrow in the planes of today."

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power to operate very large cargo doors, winches, and loading devices.

Use of High Pressures

Such extensive use of hydraulic power has necessitated many advancements in its control and application. In most cases, safety devices, automatic operation, and heavy loads have made great changes in the hydraulic system as a whole. The foremost change is in the necessity to use higher pressures. Before the war, commercial aircraft operated at 600 to 800 psi. Today, most military airplanes employ hydraulic systems operating at pressures of 1,350 to 1,500 psi. In fact, in one case pressures have gone up to 3,000 psi. The trend is toward this higher pressure, and it is safe to say that within a year or two all hydraulic systems in new aircraft will be between 2,000 and 3,000 psi.

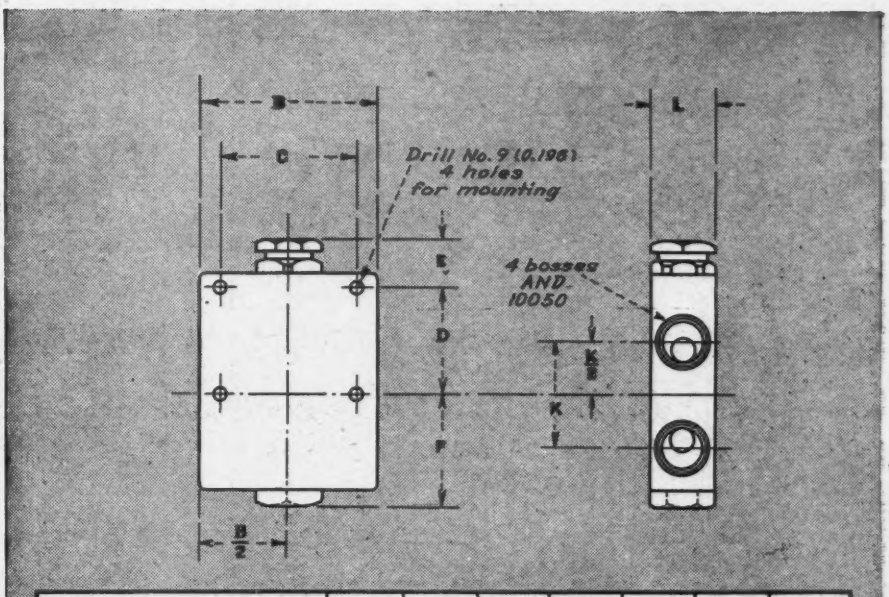
The control of pressure at 600 or 800 psi. is a relatively simple matter, especially since the small quantity of hydraulic devices and fineness of control is not critical. However, at pressures above 1,500 psi. with a multitude of devices, of timing, and of automatic operation, the control of hydraulic pressure becomes an exacting technique. It is our purpose in this series to illustrate, describe, and discuss methods and means of controlling pressure in aircraft hydraulic systems.

In general, pressure control devices fall into the following groups:

1. Relief valves
2. Pressure regulator valves
3. Variable displacement or self-regulating pumps
4. Hydraulic power valves
5. Hydraulic boosters and deboosters

A relief valve is a device which, when placed in a hydraulic system, limits the pressure of that system to that pressure at which it has been set. It is analogous to a fuse in an electric system, since it prevents the build up of pressure beyond a given point. Simply speaking, a spring pressure works against the hydraulic pressure with some closure medium or seal between them. When the hydraulic pressure builds up above the spring load setting, the spring is forced to compress, allowing the fluid to flow around the sealing member which is held in place by the spring.

Relief valves have been used in hydraulic systems since the earliest days. The simplest and most common type consists of very little more than a steel ball seated against a pressure orifice with a spring of adjustable tension shouldering against the ball. An aircraft version of this valve is shown in Fig. 1. As can be seen from this figure, the valve consists of an aluminum body into which is inserted a steel seat. An externally threaded steel sleeve containing six radial holes is screwed down



AN. DASH NUMBERS			A	B	C	D	E	F	K
Press. Range 1,000 to 1,500 lb.	Press. Range 1,500 to 2,100 lb.	Press. Range 1,000 to 2,100 lb.	Tube Size	+ 1/64 −	+0.005 −0.005	+0.005 −0.005	Max.	Max.	+ 1/64 −
-4A	-4B	-4AB	1/4	2 3/16	1.375	1.3125	1 1/4	1 7/16	1 5/16
-6A	-6B	-6AB	3/8	2 5/8	1.750	1.500	1 1/2	1 3/4	1 1/2
-8A	-8B	-8AB	1/2	2 13/16	2.125	1.750	1 3/4	2	1 3/4
-12A	-12B	-12AB	3/4	3 5/8	2.875	2.125	2	2 3/4	2 1/8

Fig. 3. Replica for standard AN relief valves.

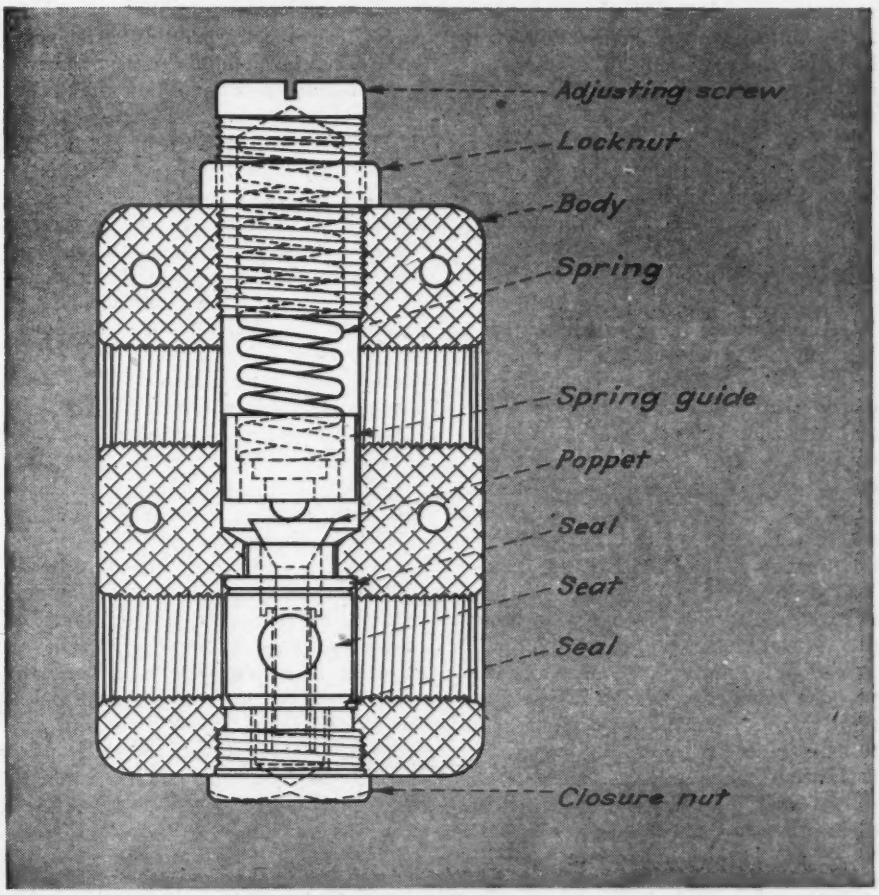


Fig. 4. Kenyon Instrument Co. relief valve.

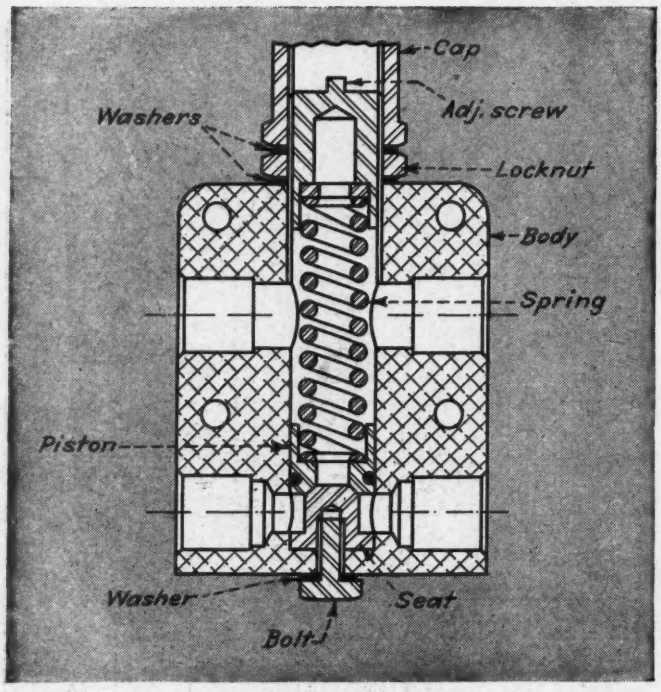


Fig. 5. Adel Precision Products Corp. relief valve.

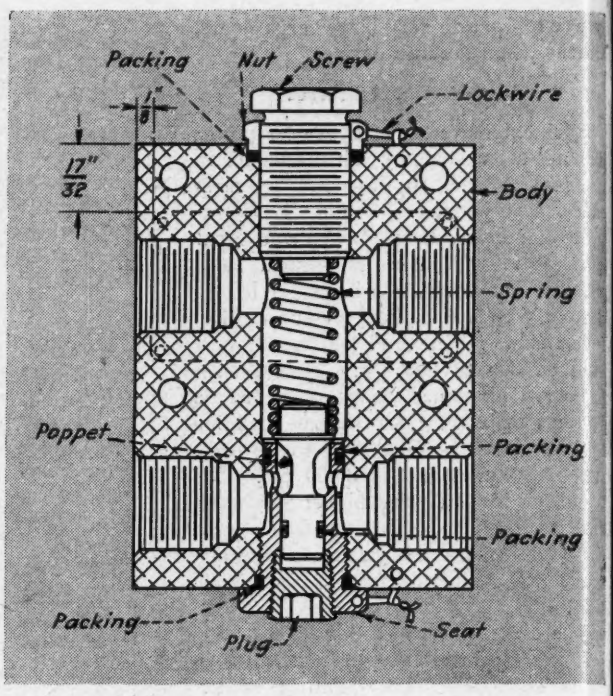


Fig. 6. Greer Hydraulics Inc. relief valve.

securely against the seat, sealing it with the body against leakage. A steel ball sits on the seat causing an effective seal against pressure. The spring seats against the ball through the spring retainer or stop, and the relief pressure is adjusted by means of a steel adjusting screw threaded into the top of the sleeve. After adjustment is made, this screw is locked in position by a steel lock nut and an aluminum cap is screwed over the sleeve closing the assembly.

For effective sealing and operation, the seat for the ball must form a perfect circle, likewise must be sharp and free of all burrs, tool marks, or nicks. The ball must be retained so that it finds its seat directly without possibility of hunting.

In installation, the pressure system is connected at *A* with a line to the return manifold at *B*. Fluid is prevented from bleeding off from *A* to *B* by the ball sealing held against the seat by the pressure of the spring. This pressure may be increased or decreased by changing the adjusting screw setting. As pressure at *A* builds up against the tension of the spring, the ball is lifted off its seat and the pressure is controlled by allowing the fluid to flow through *A* to *B* into the return line.

Although this type of valve was very popular for many years and was for a time the only means of pressure control in aircraft hydraulic systems, it has been made almost obsolete by newer designs in recent years. Advantages offered by the ball type relief valve lie in its simplicity, low cost, and low weight. However, these factors are overbalanced because the ball, when relieving pressure, chatters, causing uncomfortable noises, aside from beating out of its seat, and giving very poor control in limiting the flow in that short period between cracking pressure, full flow pressure and shut off pressure.

For efficient operation of the hydraulic system, the Army Air Forces and the Navy Bureau of Aeronautics, after years of research in the industry, have arrived at a pressure flow condition that relief valves should meet. A curve showing this requirement is given in Fig. 2. As can be seen from this curve, it is desirable for the valve to start relieving, or to crack, as close to the full flow relief pressure as possible. A maximum of 10 percent of full flow pressure has been set for this. On the other hand, it is necessary for the valve to completely shut off as close to full flow pressure as possible, and a maximum of 15 percent has been placed on this.

In other words, for correct operation of a relief valve, the valve must start to relieve within 10 percent of its rated full flow pressure, completely shutting off within 15 percent of this pressure. The sharper and closer this curve to the full flow pressure line set at 100 percent, the better the valve operation. The reason for this is obvious, for in an airplane it is undesirable to lose the pressure in the hydraulic system below the relief setting at any time and if a wide curve were allowed the static pressure in the hydraulic system would be almost entirely lost once the relief pressure was reached.

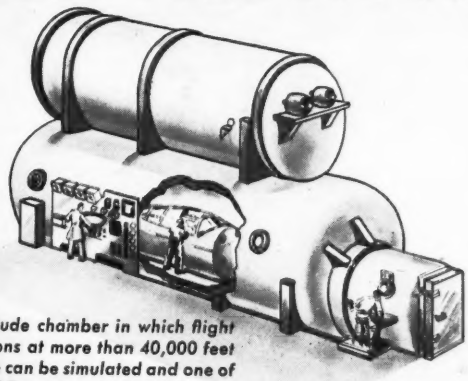
Present day relief valves accomplish the above requirements by strict attention to spring design, careful guiding of the valve poppet in its seat, and clean seating edge against the poppet. Poppets have entirely replaced balls in relief valves because they offer a good means of guiding the valve and its seat as well as dash pot action with the poppet shanks. However, poppets do not entirely do away with "screaming" when relief valves are operating. This objectionable noise is due to the fact that the oil is forced through a very small circular annulus against a high load at very high velocity. Result is a wire-drawing effect which results in the high pitch whistle or "screaming" noise. Although this noise is not harmful to the valve, its operation, or the hydraulic system, it is very annoying to the pilot and is therefore objectionable.

Most manufacturers of relief valves have eliminated this noise by clever design of the valve poppet head or seat so that there is reversal of flow of oil after passing through the restricted annulus, thus breaking up the wire-drawing effect. Other manufacturers have turned to differential loading or non-metallic materials which do not cause wire-drawing by virtue of their soft nature and resistance to internal vibration.

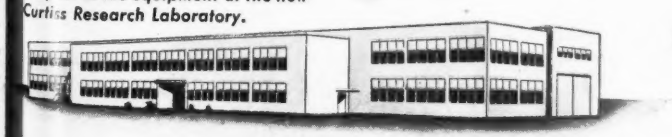
Pressure control in aircraft hydraulic systems is accomplished by pressure regulator valves rather than relief valves. The relief valve has been reduced to the function of a safety valve in case the pressure regulator ceases to function, and it provides a means of preventing excessive pressures from building up due to thermal expansion of the hydraulic fluid in a closed line. Therefore,

(*Turn to page* 360)

KEEP YOUR EYE ON *Tomorrow's Horizons*



An altitude chamber in which flight conditions at more than 40,000 feet altitude can be simulated and one of the world's most modern wind tunnels are part of the equipment at the new Curtiss Research Laboratory.



Beyond measure are the engineering advances, the improvements in manufacturing methods, which are the product of Curtiss-Wright's vast wartime program. When war is done, this rich experience will give the world safer, speedier, more luxurious airliners—swifter, more economical cargo carriers.

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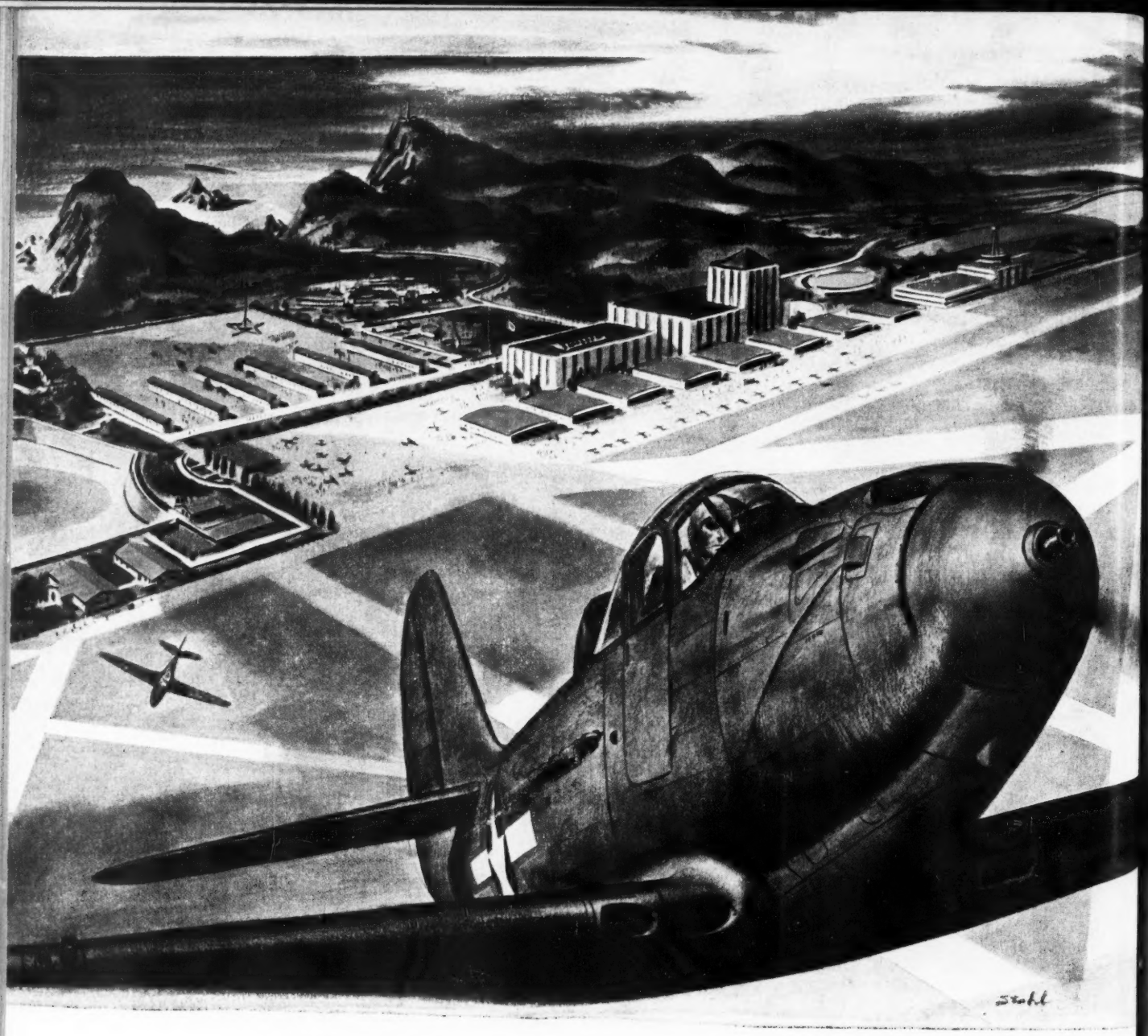

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Very soon now, there'll be well over 2,000,000 men in the U. S. Army Air Forces.

Flight is their business.

War has taught them the machines, the techniques, the language of flight. They recognize no impassable barriers of land or sea.

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NACA
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The story of the NACA is the story of American aviation. Neither could well exist without the other. If either fails, the other cannot live. And so we — if we would exist as a great nation — must keep them both great.

ONE OF THE MOST FAR REACHING pieces of legislation, so far as the destiny of our country was concerned, was the Act of Congress of Mar. 5, 1915, establishing the National Advisory Committee for Aeronautics, charged with the "supervision and direction of the scientific study of the problems of flight, with a view to their practical solution, the determination of problems which should be experimentally attacked, and their investigation and application to practical questions of aeronautics."

There is abundant evidence to prove that this body of men, in devoting their time and energy to the service of aviation, have, like the RAF, earned that high praise expressed in the meaningful line, "Never have so many owed so much to so few."

Congress must have believed, with its notorious conservatism, that the new Committee, being non-political, was of little importance. Indeed, the record shows us that the NACA only appropriated $5,000 annually for the first two years. However, the infant grew despite malnutrition, and we find that the appropriation for 1917 was $87,515.70—due, no doubt, to "war hysteria".

Then, for the first time, the NACA had money enough to work with. Regardless of public opinion, which relegated theorists to pure theory, the men who took public money began to give the public more than their money's worth. Of course, with the exception of the manufacturers, the pilots, the designers, and the men who in flying risked their lives—and lost them—nobody thought much about what this NACA was doing. Not having the gift of prophecy, the public cannot be blamed for not foreseeing that the foundations of world power were being laid before their blinded eyes.

In any event, the NACA kept on working, and American aircraft got better and better. Sweden used American planes for transport, so did Holland, the home of the great Fokker. In every part of the world American planes were familiar. Even the uncivilized natives of Asia and Africa could tell the "dam-yankee" planes by the smooth exhaust of their engines. Even when it wasn't so smooth they still flew—there seemed to be something uncanny about the way they kept running when, by all the rules, they should have crashed.

Those who talked about "Yankee luck" had probably never heard about that small, hard working band of thinkers and experimenters who spent their time looking for trouble, making the good better, and never saying "good enough" . . . men whose work was so unspectacular that they were almost unknown, but so important that every airplane designer in the world uses their findings to guide him and accepts their reports as the last word on the subject.

The aviation industry grew up; so did the NACA. The *Aircraft Yearbook* for 1922 devoted three pages to the report of the President of the United States regarding the Committee. He said: "I urge upon the Congress the advisability of giving heed to the recommendations of the Committee." Probably this was the first recognition in high places accorded the Committee.

Suddenly, due no doubt to the outbreak of a rash of transatlantic flights, the aviation industry began to boom. Congress, in 1926, "gave heed to the recommendations of the Committee" and voted it over $500,000 for the first time. Whoever they were (their names are buried in the obscurity of the *Congressional Record*) the nation owes them a debt which only history can well evaluate. This country, despite the old guard in both services, was destined to be an air power; we had resources, men, and materials; we only needed more technical research.

Thus it was 1926, by the record, that marked the time when the NACA could really augment its effective work. Investigations were made for the Army on various types of wing sections; experiments were made concerning directional guidance of airplanes by radio beams from the ground; tests were made of duralumin (that strange new material) for aircraft; fuel injection was not only studied but was reported-on to the general benefit.

The NACA was becoming one of the mainstays of American aviation. The men who composed it had not only jus-

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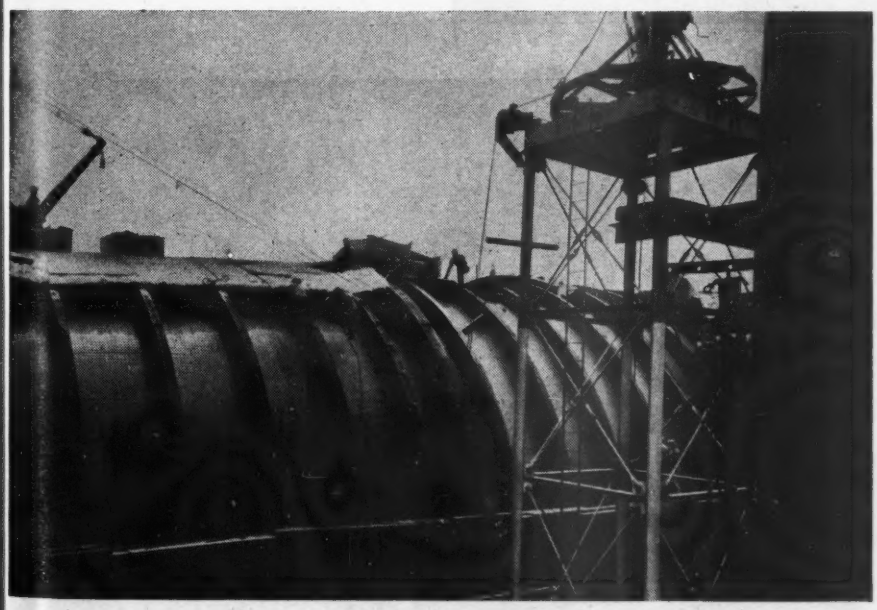
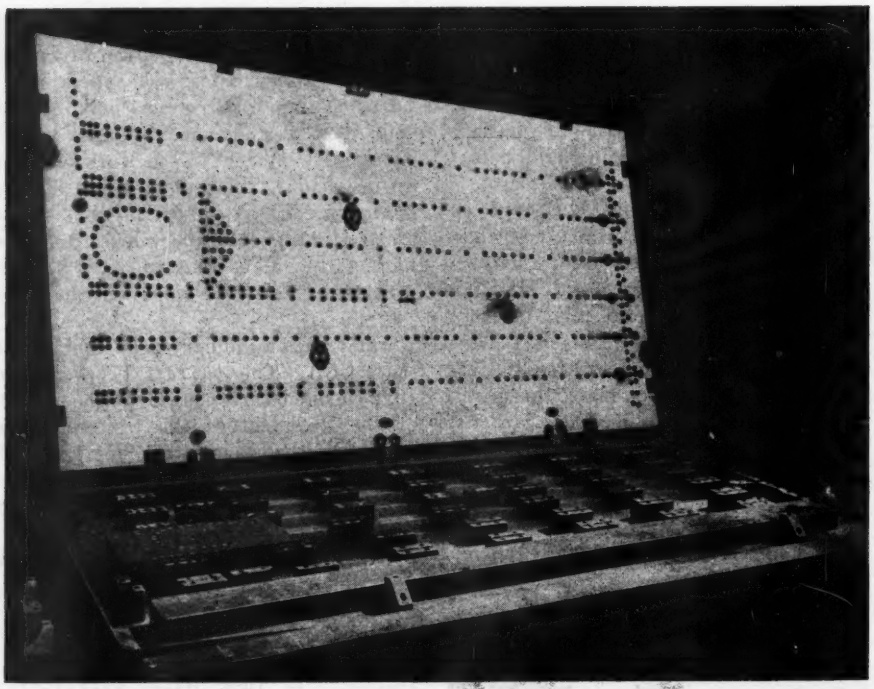


Construction view of NACA altitude wind tunnel at Cleveland Engineering Laboratory shows workers laying 2½-in. Fiberglas sheets which can hold temperature down to —48 deg. F. Steel-walled tunnel, which is 262 ft. long and from 20 to 51 ft. dia., mounts 32-ft., 12-blade, 18,000-hp. fan developing 500 mph. wind. With capacity to test 3,000 hp. engine, huge unit is refrigerated by 14 compressors, each of 1,500 hp., and is exhausted by four 1,750 hp. pumps. Working pressure can be as low as 4 psi. absolute.

These Horizontal Jigs Boost Aircraft Panel Fabrication

By **RALPH H. RUUD**, *North American Aviation, Inc.*

Time per jig was cut from 300 man-hours to 77.5 when North American California Division went from the steel-vertical to the Masonite-horizontal units. Features of improved method are traveling jack-knife drills and combination drill-countersinking tools.



Horizontal Masonite jigs are utilized. This is one for fabricating stringers and flat panels. Stringers are first placed in jigs, with flat panel laid over them. Steel apply jig, hinged at back, is then lowered over assembly. Holes are drilled from top side, using a radial-arm drill press which rolls back and forth on a track on each side of drill table.

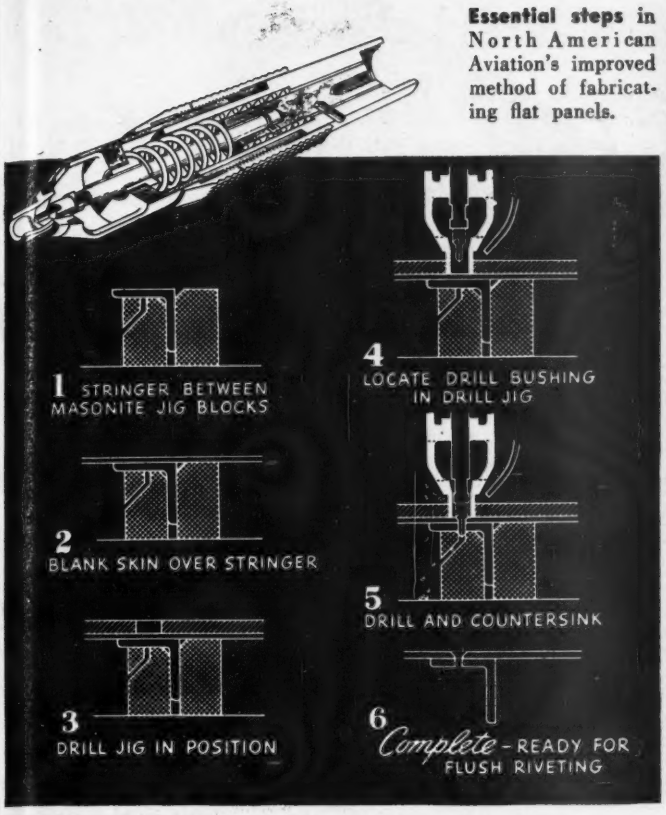
Drilling one line of holes after steel apply jig has been lowered over panel. White lines are part of color code, indicating size of hole to be drilled and whether it should be countersunk. Darker colors, such as red and yellow, do not show in photograph. Drill bit is changed for each color code.

FOR PRODUCTION ON PANELS which are too heavy to punch and rivet, an improved method of fabrication is to place the stringers, doublers, and skin (flat metal sheets) in a horizontal Masonite jig. A ¾-in. steel apply jig, hinged to the back of the lower part of this horizontal jig, is lowered over the assembly.

A radial-arm drill press which rolls on a track on each side of a table then is used to drill or drill-countersink the panels. Skin fasteners are inserted in the panel during the drilling operation to maintain hole alignment. When the drilling is completed, the panels are removed, filled with rivets, and fed through a large gang rivet squeezer.

A one-piece combination drill-countersinking tool is employed, set within a sleeve, similar to a standard countersink. When the drill is not pressed against the work, the spring-loaded sleeve extends beyond the drill point. When the actuating lever is brought down, the sleeve fits into the hole in the apply jig, thus locating the hole and preventing the countersink from routing elongated holes.

Further pressure brings the drill down to the work and the spring-loaded sleeve acts as a pressure pad, keeping the skin tight against the stringer and


1 STRINGER BETWEEN MASONITE JIG BLOCKS
2 BLANK SKIN OVER STRINGER
3 DRILL JIG IN POSITION
4 LOCATE DRILL BUSHING IN DRILL JIG
5 DRILL AND COUNTERSINK
6 Complete - READY FOR FLUSH RIVETING

Essential steps in North American Aviation's improved method of fabricating flat panels.

When drilling or drill-countersinking is completed on drill table, panel is removed, holes are filled with proper size rivets, then panel is fed through this heavy gang rivet squeezer.

preventing the accumulation of chips between the skin and the stringer. The sleeve can be adjusted to assure proper depth of the countersunk hole.

Chips are blown from the work by an air nozzle, thus preventing the panel from becoming scratched and the tool from becoming clogged. The apply jig is color-coded to indicate the size of hole and whether the hole should be countersunk. As an example, yellow may indicate a $\frac{5}{32}$-in. countersunk hole, and red may mean a $\frac{1}{8}$-in. drilled hole, and so on.

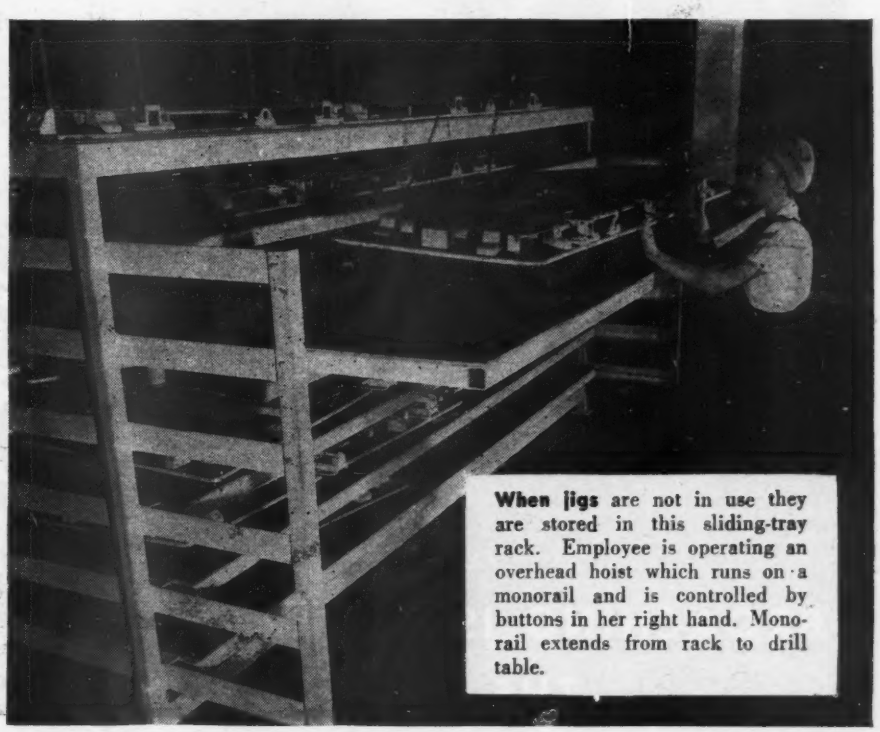
The jig is constructed of Masonite instead of the critical steel engineers call for on the vertical type panel assembly jigs. Due to the horizontal position of the jig, no clamps are needed to hold the parts in place because the weight of the apply jig is usually sufficient. The Masonite jigs are light, and when not in use they can be removed from the drill table and stored in tiers in a rack, thus conserving valuable floor space.

Man-Hours Cut

A comparison of average construction man-hours for six different jigs gave a figure of 300 man-hours per jig for the old type vertical steel jigs as against 77.5 man-hours for the new type horizontal Masonite jigs. The engineering drawing of the panel is reproduced on the steel apply jig by an X-ray photographic reproduction process which eliminates the necessity of layout by the jig builder.

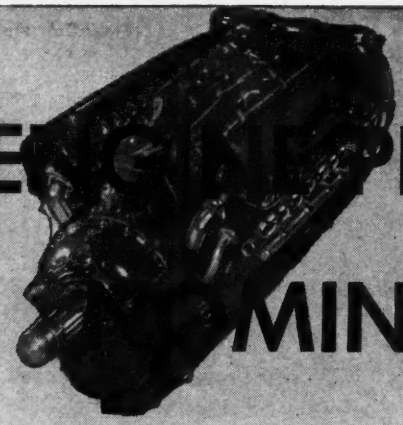
Whereas the previous method required 14 sec. to pilot drill, drill to size, and countersink each hole, the new method drill-countersinks the hole in one instead of three operations, and it does it in 4 sec. for each hole, or about 29 percent of the former time. Pilot holes are eliminated by use of the apply drill jigs, which locate the holes.

Other advantages of this method of fabrication are better quality, less operator fatigue, release of hand drills for other work, reduction of drill breakage, elimination of stringer clamps, fewer mistakes, simplification of the training of new employees, and consistent assurance of a good quality of workmanship.

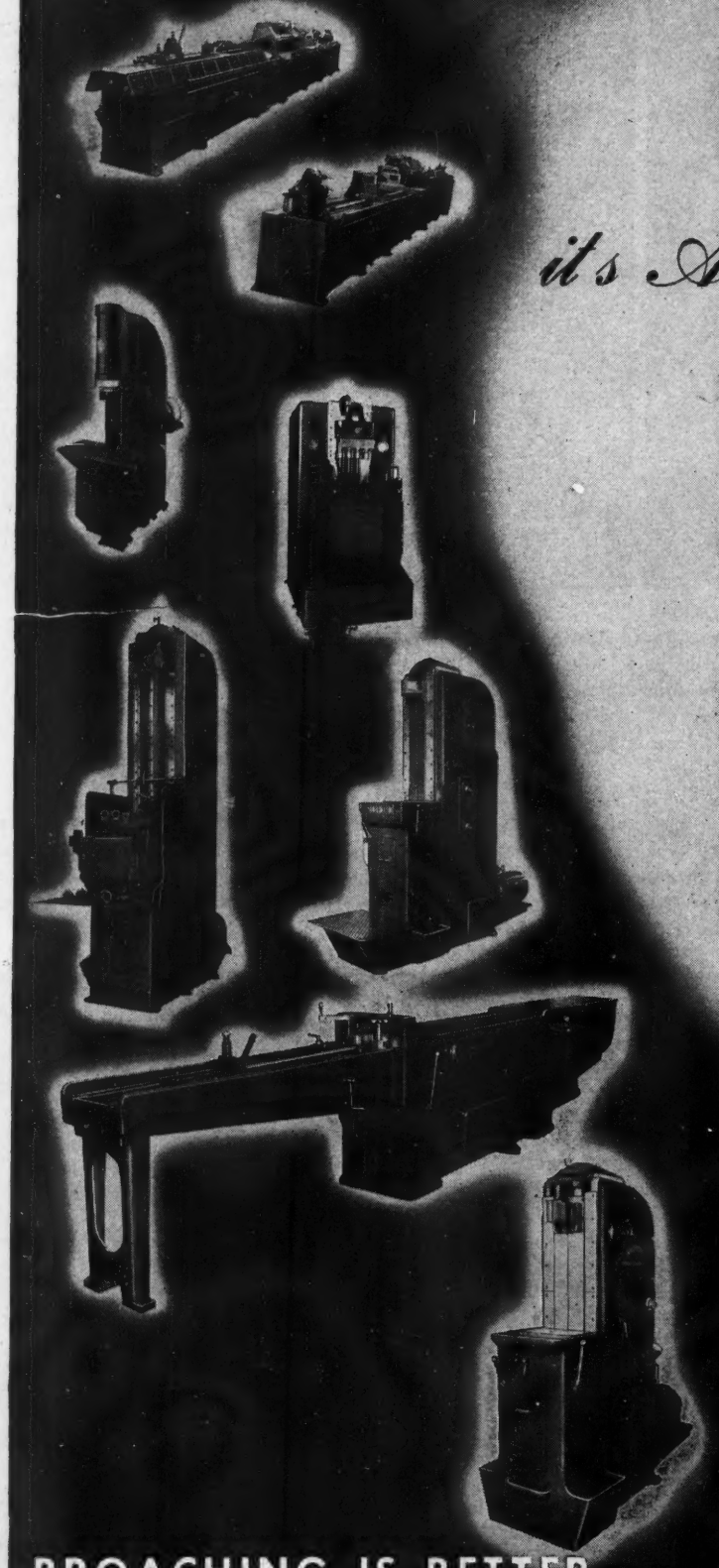


When jigs are not in use they are stored in this sliding-tray rack. Employee is operating an overhead hoist which runs on a monorail and is controlled by buttons in her right hand. Monorail extends from rack to drill table.

THIS AIRCRAFT ENGINE PLANT ...MINATES



it's All-American Team



So high is the production-with-precision obtained by broaching that one machine is ample for most metal working plants. Few have as many as 10 or 15.

Consider, therefore, the importance of this particular aircraft engine plant in the broaching picture, with 91 American machines!

Their personnel *knows* broaching. They know the value of dealing with an old-line company whose principals have been identified with broaching since the turn of the century. They know, too, the importance of a *complete* broaching service—machines, tools, and engineering — for winning war production, profitable post-war production.

Significant is this overwhelming vote of confidence in American Broach equipment.

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AIRCRAFT PRODUCTION ANALYSIS
Key to Assembly Line Efficiency

Part II

By **LOREN F. DORMAN,** *Production Design Engineer*
Curtiss-Wright Corp., Aircraft Div., Missouri

More planes *faster* is the double-barreled achievement of 1943 aircraft line production. This concluding study further details the analytical techniques behind this accomplishment.

TO ESTABLISH an efficient aircraft assembly line, it is necessary that the complicated fabrication be reduced to simple planning operations. And this calls for thorough production analyses of design and manufacture.

Thus far (Part I, Nov. AVIATION) we have considered the details of production breakdown, production and line assembly, and production control. Next step in the planning is the precise allocation of working time to each operation.

Work allocation zones should be determined and a perspective zone definition drawing issued (Fig. 5). A work allocation zone is that section of an aircraft which has been designated by code number as a specific working space required by one man. The established zone is used in conjunction with a predetermined position or station for the allocation of a specific amount of work at a certain time. A maximum zone work-timing element should be determined, measured in minutes for a periodically moving line and in minutes or feet per minute for a continuously moving line.

Total possible applied man-hours per major final assembly unit should be determined. From the information established, those engaged in planning should then determine a complete airplane production cycle relative to time-contract requirements. This will define final assembly requirements, feeder line requirements, sub- and bench-assembly, major and minor assembly fixtures required, number of handling fixtures required, and the number of final assembly stations.

From the information, a preliminary

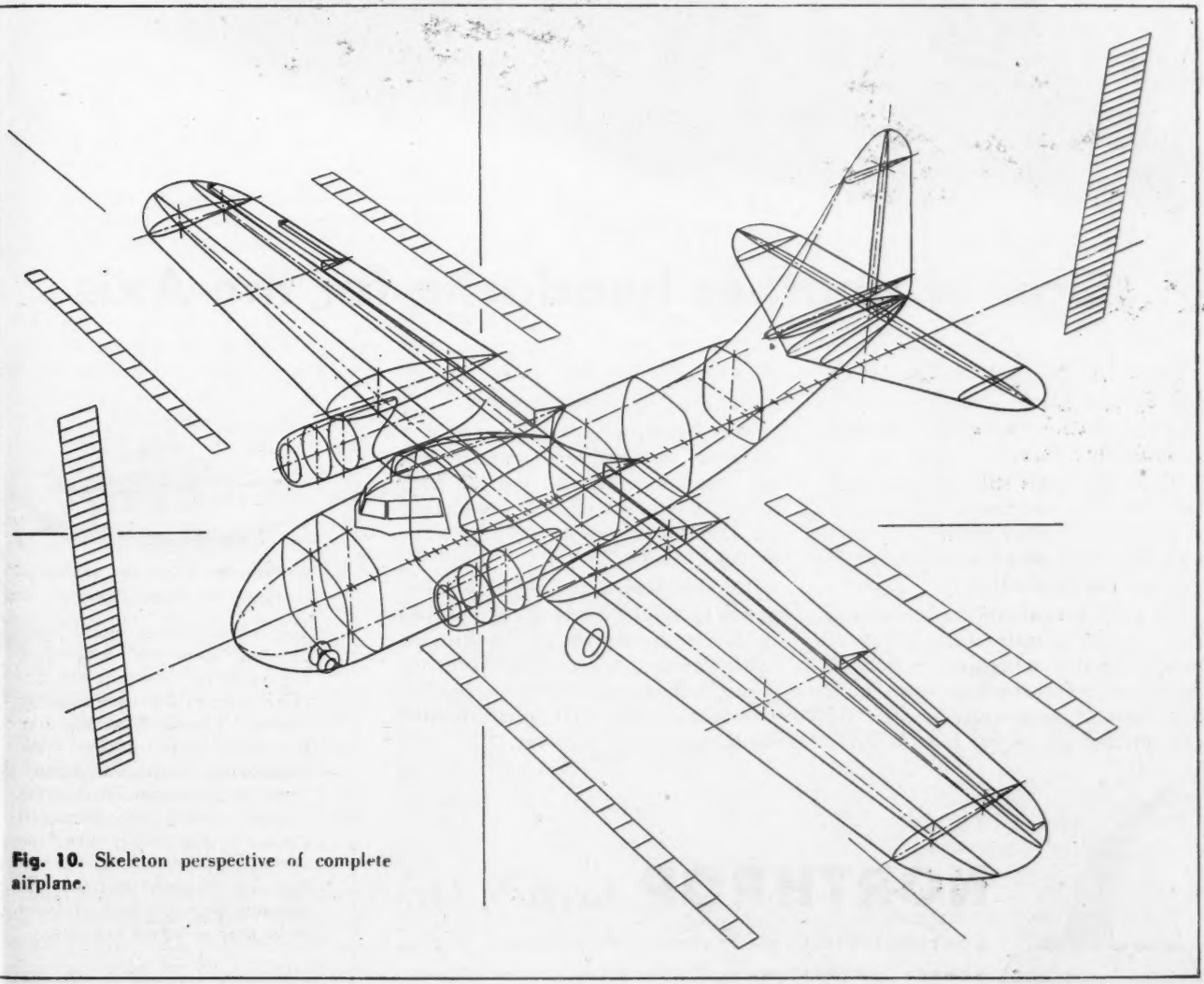

Fig. 10. Skeleton perspective of complete airplane.

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Sign of another headache for the Axis

DON'T THINK that America's job against Japan and Germany is now almost done. The Axis fights with undiminished fury.

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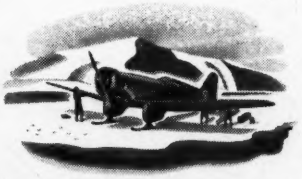
To help overwhelm such enemies, the U.S. air industry faces a job of production that is titanic—far beyond the resources of any other people on this earth. It must create greater and ever greater air might. It must drive ahead night and day toward an air power never before dreamed of.

The Northrop group of airplane designers and builders shares in this all-consuming task. To the job they bring not only the skills of production but a forward looking concept in aerodynamic design.

The warplanes devised and being produced by the Northrop group will speak for themselves in the skies of battle. And as they speak, the Northrop group will be working on—creating and testing the still more deadly Northrop aircraft to come.



Smithsonian Institution enshrines famed Northrop "Gamma"

The Northrop group draws upon the same "know-how" that created the Northrop "Gamma". The airplane pictured is the one flown by Explorer Lincoln Ellsworth over the Antarctic, and is now in the Smithsonian Institution. Aerodynamically in advance of its time, the Gamma, built in 1933, pioneered the use of split trailing edge flaps now widely used on American military and transport aircraft. The Gammas were the first airplanes to be used as attack bombers.

NORTHROP *Aircraft, Inc.*

NORTHROP FIELD, HAWTHORNE, CALIFORNIA, U. S. A.

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.

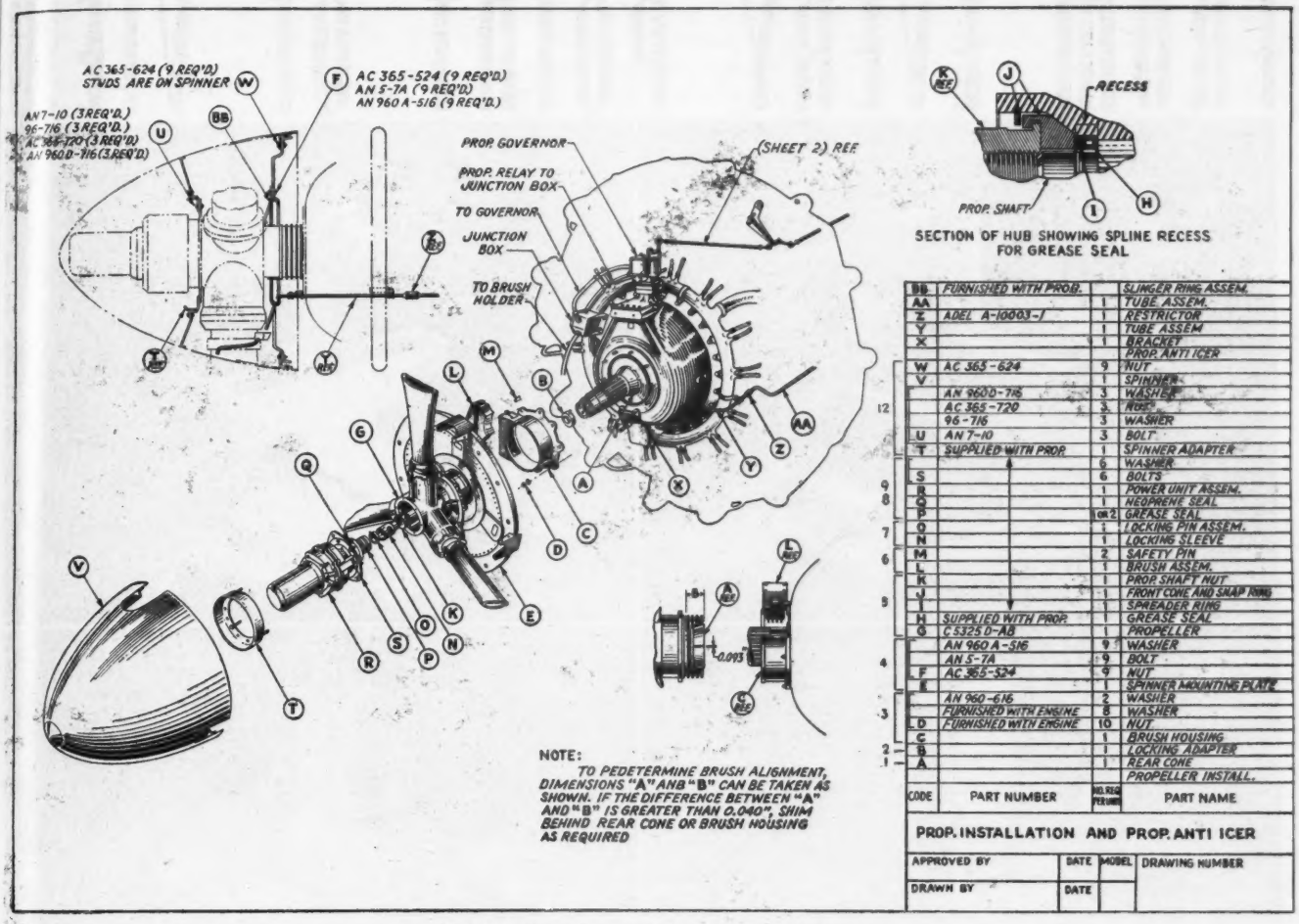

AC 365-624 (9 REQ'D.) STUDS ARE ON SPINNER
AC 365-524 (9 REQ'D.) AN 5-7A (9 REQ'D.) AN 960 A-516 (9 REQ'D.)
AN7-10 (3 REQ'D.) 96-716 (3 REQ'D.) AC 365-720 (3 REQ'D.) AN 960D-716 (3 REQ'D.)
PROP. GOVERNOR
PROP. RELAY TO JUNCTION BOX
TO GOVERNOR
JUNCTION BOX
TO BRUSH HOLDER
(SHEET 2) REF
RECESS
PROP. SHAFT
SECTION OF HUB SHOWING SPLINE RECESS FOR GREASE SEAL
NOTE:
TO PEDETERMINE BRUSH ALIGNMENT, DIMENSIONS "A" AND "B" CAN BE TAKEN AS SHOWN. IF THE DIFFERENCE BETWEEN "A" AND "B" IS GREATER THAN 0.040", SHIM BEHIND REAR CONE OR BRUSH HOUSING AS REQUIRED
BB FURNISHED WITH PROP. 1 SLINGER RING ASSEM.
AA 1 TUBE ASSEM.
Z ADEL A-10003-1 1 RESTRICTOR
Y 1 TUBE ASSEM
X 1 BRACKET
PROP. ANTI ICER
W AC 365-624 9 NUT
V 1 SPINNER
AN 960D-716 3 WASHER
AC 365-720 3 NUT
96-716 3 WASHER
U AN 7-10 3 BOLT
T SUPPLIED WITH PROP. 1 SPINNER ADAPTER
6 WASHER
S 6 BOLTS
R 1 POWER UNIT ASSEM.
Q 1 NEOPRENE SEAL
P OR 2 GREASE SEAL
O 1 LOCKING PIN ASSEM.
N 1 LOCKING SLEEVE
M 2 SAFETY PIN
L 1 BRUSH ASSEM.
K 1 PROP. SHAFT NUT
J 1 FRONT CONE AND SNAP RING
1 SPREADER RING
H SUPPLIED WITH PROP. 1 GREASE SEAL
G C 5325 D-A8 1 PROPELLER
AN 960 A-516 9 WASHER
AN 5-7A 9 BOLT
F AC 365-524 9 NUT
E 1 SPINNER MOUNTING PLATE
AN 960-616 2 WASHER
FURNISHED WITH ENGINE 8 WASHER
D FURNISHED WITH ENGINE 10 NUT
C 1 BRUSH HOUSING
B 1 LOCKING ADAPTER
A 1 REAR CONE
PROPELLER INSTALL.
CODE PART NUMBER NO. REQ. PER UNIT PART NAME
PROP. INSTALLATION AND PROP. ANTI ICER
APPROVED BY DATE MODEL DRAWING NUMBER
DRAWN BY DATE

Fig. 11. Propeller installation with anti-icer.

shop floor plan should be made by the plant layout group based on general plant arrangement, parts flow and storage, assembly flow and storage, feeder lines, conveyor systems, handling fixtures, and production control stations.

Normally, a prototype airplane is planned and constructed on an expedited basis. With this in mind, in addition to the fact that any new model is subject to engineering changes, the production prototype should not be considered suitable for production line development. Under a development program of this nature, it has been found desirable to select production airplane No. 10 or No. 25 as the production development prototype.

Stage analysis should progress directly into detailed station analysis—planning and combining individual stage-station job units with similar units of other stages for the establishment of final line assembly job units. Detailed study of each functional installation unit relative to its structural unit work allocation zone should be made, based on stage unit priorities and coordinated with the preliminary line layout.

A number of preliminary stations should be determined for each individual stage by dividing the number of stage installation units by the number of

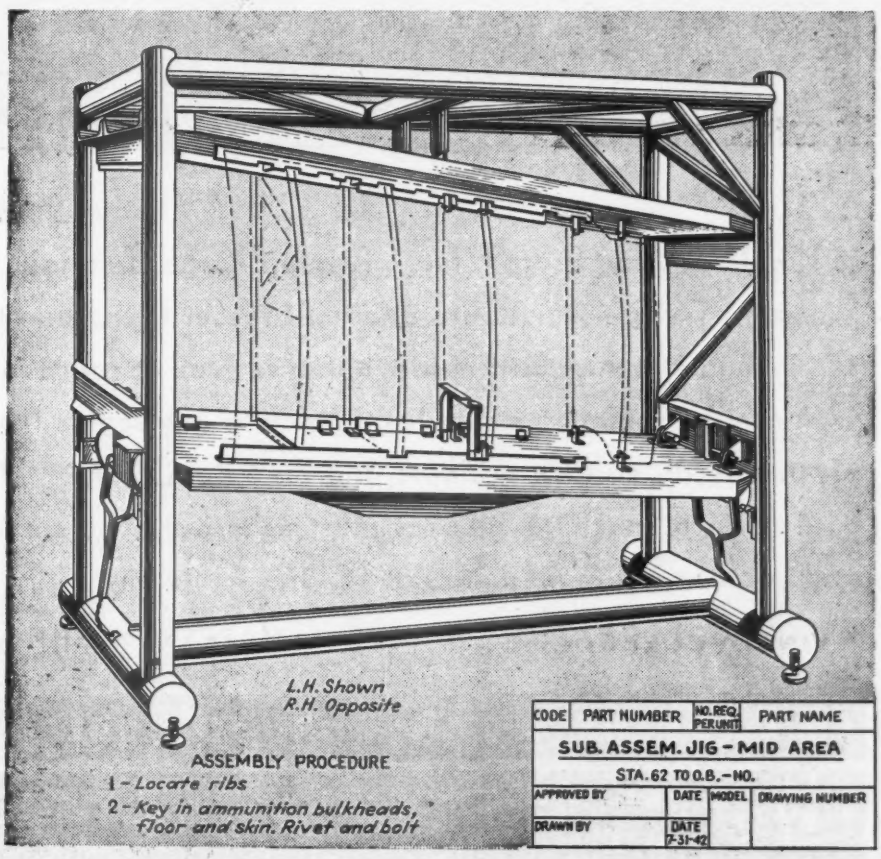
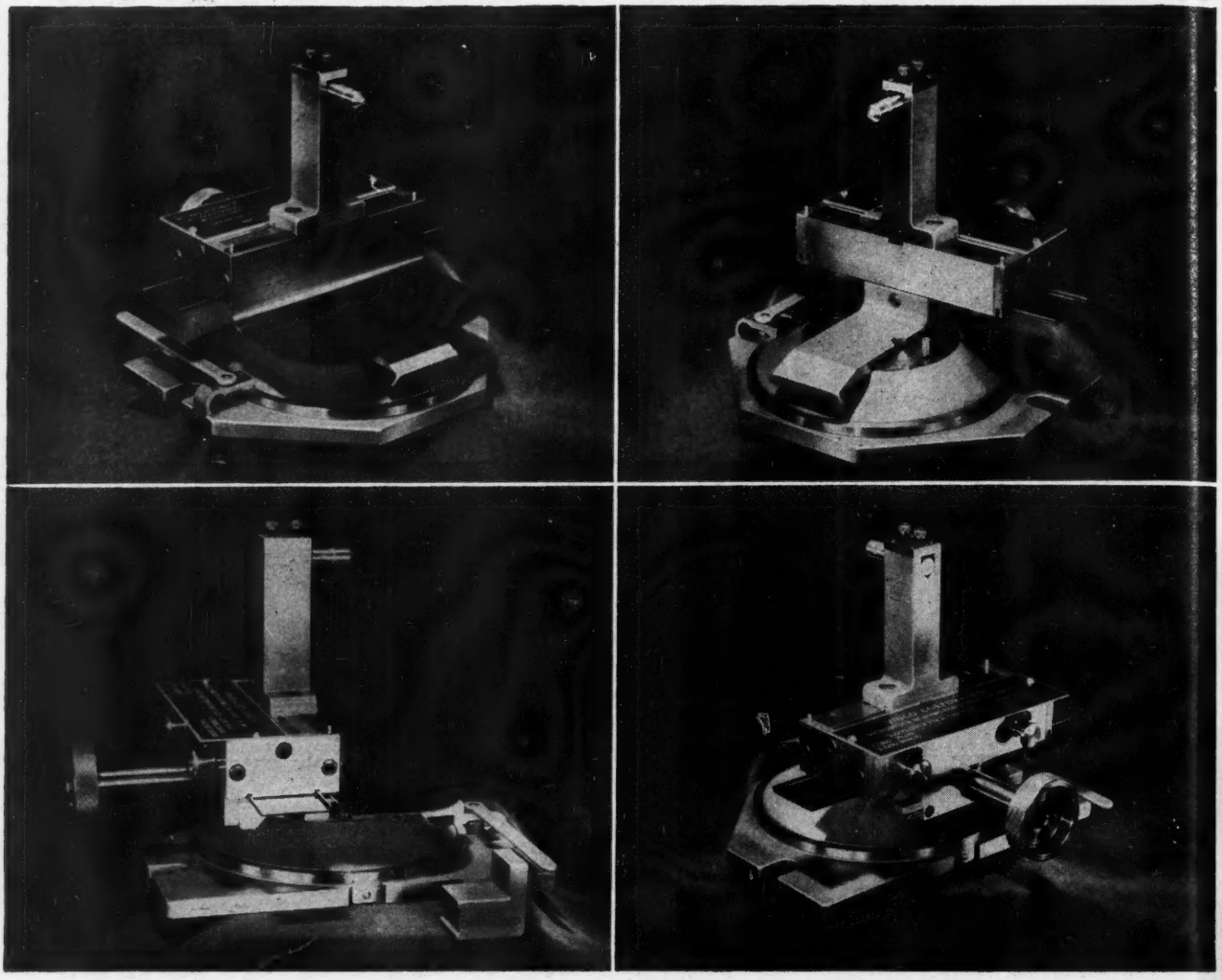

L.H. Shown
R.H. Opposite
ASSEMBLY PROCEDURE
1 - Locate ribs
2 - Key in ammunition bulkheads, floor and skin. Rivet and bolt
CODE PART NUMBER NO. REQ. PER UNIT PART NAME
SUB. ASSEM. JIG - MID AREA
STA. 62 TO O.B. - NO.
APPROVED BY DATE MODEL DRAWING NUMBER
DRAWN BY DATE 7-31-42

Fig. 9. Mid-area subassembly jig.

FROM EVERY POINT OF VIEW



Whether the wheel dressing job to be done is simple or complicated, fine or rough, large or small, from every point of view, the Vinco B-1 (Angle Tangent to Radius) Dresser is the one to use. Grinding wheels up to 14" in diameter may be dressed, either convex or concave with radii up to 2½" diameter with any combination of angles tangent to any radius. The B-1 Dresser may be used on practically all surface grinders and on external, internal and cutter grinders (in some cases, Vinco special Sub-Bases must be used). You can't go wrong with a Vinco B-1—and you can get immediate delivery from stock.

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working zones. The stage unit priorities should be coordinated with the approximated stations and numbered accordingly, to establish the unit priority relative to zone and stage-station.

The unit items determined for zone stage-station installation represent one-man job units for each stage. Each of these stage job units will eventually become a part of a complete job unit relative to the entire assembly line, or, if sufficiently large within themselves, may become individually complete line assembly job units.

Preliminary job units should be recorded by means of a job unit operation sheet (Fig. 6) carrying designation numbers for the following: Specific model, stage (by engineering unit designation or by assigned stage letter), stage-station, and work allocation zone. Preliminary job units for all stages should then be coordinated with similar stage-station priorities and zones. Thus, zone priorities will be found, and by alloting to each zone only that amount of work which can be accomplished in the estimated maximum working time, the number of final line assembly stations will be determined.

Having worked to a consistent working-time element, the stations will be approximately balanced, requiring additional refinement as job unit time estimates are revised, changes are made, etc. Job unit numbers should drop the stage-station designation upon becoming a part of a specific line assembly job unit. New numbers should define the specific model, station and zone.

Two proven production procedures items are key sheets and work loading production charts. Key sheets are skeleton perspective diagrams of the major units issued as black-and-white prints to the line assembly group. Planners analyzing stage, stations, or zones may mark up a key sheet with block sketches of the items installed in general relationship to the diagram, listing all attaching parts, estimated time, etc. These sheets may serve as a visual means of work-loading coordination.

A work loading production chart (Fig. 7) is similar to the flat-pattern plant layout and assembly line layout. A work loading chart should portray only one particular assembly line, increased in scale, and need not incorporate all line loops or bends. Under each station should be a series of tabs listed by zone, upon which has been printed the job unit name and number and estimated time. By shifting the various tabs from station to station, station-time balancing may be easily accomplished and the results perceived at a glance.

As station analysis progresses, job units should be checked against the current airplane for major changes. By the time job units are being prepared, the pre-selected production development prototype (airplane No. 10 or No.

(*Turn to page* 360)

Fig. 12. Delivery end of final assembly line. Chain and line motor are seen in right foreground.

Winning the War with Scrap

Everything except dust on the floors is saved by NAA's Texas Division in its well organized, dividend paying salvage program.

EVERY BY-PRODUCT ITEM—each scrap and shaving, worn-out cutting tools and files, lumber from shipping cases, even paper and paper fasteners and clips—are carefully segregated at North American Aviation in Texas. They're either salvaged for re-use or returned to processors to be put back into the war effort in the form of new material.

Working on the theory that every little bit—even the tiniest rivet or most gossamer thread of metal machinings—helps in winning the war, the material conservation department at the NAA plants in Dallas has for many months been conducting a vigorous campaign against waste.

In reality, the campaign is two-fold but works toward a single purpose, the elimination of waste. Employees, from the day they start on the job in either of the two big manufacturing plants where the company produces P-51 *Mustangs, Texan* trainers, and B-24 *Liberators,* understand that they must not waste material. At the same time they are taught to segregate the scrap from their job operations so that it can either be quickly returned to the processors or sent directly back into production.

These salvage-conscious employees are responsible, in a great measure, for the record of enormous savings of materials needed in the war effort. The cooperation between the employees and the material conservation department—for it is an employee program—has resulted in the saving of large amounts of critical materials.

Tangible results of the program include: The saving of thousands of sheets of new aluminum through the work of conservation-minded workers who constantly strive to obtain more parts and less waste from the sheets; the prevention of stopline shortages by the return of parts and materials to production by the salvage department; the re-use of lubricants and oils; a 40 percent decrease by weight in the volume of rivets, bolts, and other small parts, which were being lost to production through repairs; and, of course, the return of scrap to metal suppliers who combine it with new material and get it back into production.

The cooperation between the conservation department and the individual employee begins the day the latter starts on the job. Part of the induction instruction given every new worker is devoted to material conservation. New employees who come to the plants from company-sponsored "earn-while-you-learn" training schools already are conservation-conscious through their school training. Posters, articles, and pictures in company publications constantly keep the importance of the war on waste before them. Special displays, showing the types of unnecessary waste, the causes, and the remedies, are prepared frequently by the material conservation department.

The supervisory staff of the two plants is schooled in conservation and salvage methods by the education de-

partment, which conducts in-plant training courses.

But the campaign goes much further. In each production department, salvage monitors are appointed by the department head. These workers are responsible for encouraging prevention of waste and proper segregation of scrap materials. In addition, monthly contests are conducted in each plant, with awards going to the departments which have the best scrap-segregation records. And special merit awards are presented periodically to departments with records of exceptional savings in materials through improved production methods which eliminate waste.

The conservation department maintains conservation investigators on each shift who constantly study sources of waste, make surveys to improve elimination of waste, and work with the departments to coordinate the efforts of employees and of the conservation department in curbing waste-producing conditions.

These investigators also pay monthly visits to the plants of subcontractors in order to aid them in improving their methods of waste prevention and scrap handling on company materials. They also consult with the subcontractors on conservation programs for their own materials.

Waste is a problem in multiplication. A special display held recently at the Dallas plants illustrates the point. The display was made up of rivets, bolts, and other small parts, all salvaged from trash drums. One rivet or bolt dropped on the plant floor seems insignificant—but when hundreds of fabrication department employees each drop four, five, or six rivets or bolts, the totals mount almost beyond belief.

That was several months ago. Now, however, a day's accumulation of salvaged parts can be measured in handfuls. Such visual demonstrations drive home conservation aims.

This pile of rivets, bolts, and small parts, swept up from factory floors at North American Aviation's Texas Division, was featured in stop-waste drive by material conservation department. Every member of the supervisory staff in every fabrication department was shown display. In less than a month there was a 40 percent decline in volume of such parts left lying on the floor.

Further assistance is given by helping each employee to understand and to fulfill his personal responsibility in getting the maximum number of war products out of each war material, and to segregate all unavoidable scrap.

Containers for each type of scrap material are given separate colors and labels. In the machine shop, wooden tags, correspondingly colored and labeled, are issued to workers with job orders and parts to be worked. After a machine operator checks to see that the color of his segregation tag is proper for the material he will use on his job, he hangs the tag on a bracket above his machine. When the tag goes up, conservation scrap men provide the proper scrap container. When the job is completed, scrap men clean up the machine and the tag is put back with the parts to travel with them until the final machining operations are performed.

Scrap, thus segregated at the source, is easily and quickly returned to smelters and, for this reason, much emphasis is placed upon this system at North American. Mixed scrap, which is of no value to the war effort, thus is materially reduced.

Not only are scrap drums marked with the type of material to be deposited in them but they also bear the reminder "SOS—Save Our Scrap."

Illustrating right and wrong way of handling rivets. Photo at left shows incorrect method of using paper cups, or similar small containers, to dispense rivets. This results in waste shown in the center photograph, where cup was overturned, spilling rivets. In photo on right, proper method is seen demonstrated by NAA's William R. Goodman. He picks rivets out of pocket of apron.

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A small part in victory today . . . **A BIG PART IN INDUSTRY TOMORROW**

All machinings in NAA machine shops are carefully segregated in distinctively colored containers, labeled for particular material. Hanging above Operator Paul Peck's machine is wooden tag bearing same label as on container.

Follow-up on unused parts to determine cause for rejection so that cures might be recommended was inaugurated by company's material conservation department. This program brought a 30 percent decrease in volume of rejected parts in first 60 days.

The material conservation program does not stop with reduction of waste through good work habits and scrap segregation. It includes the project of increasing the number of parts which can be obtained from one piece of material. Working with the men and women who build the planes, the conservation department has been able to save or reclaim many thousands of pounds of materials during the 15 mo. it has been a full-fledged department.

Extra parts often can be obtained by using cull or remnant stock such as is left over from the making of parts. After checking cull stock against cutting size records, cutting charts are prepared to show how excess scrap can be eliminated on future orders, or how scrap already produced can be used in making other parts.

Sheet metal, machine forming, plaster form, and die departments cooperate with the conservation department in an endeavor to have parts developed from flat patterns, thereby reducing the extra forming, trimming, and drilling operations necessary when parts are developed in the rough.

Many of the suggestions which have resulted in saving materials have come from other than conservation department employees. For example, nearly 800 in. of wire is saved on each *Texan* combat trainer built at North American, because two of the workers in the electrical and radio department were interested enough in the program to devise a new material-saving method of wire-cutting.

The janitors who sweep the factory floors have enlisted in the campaign, too. Each of them is given a 20-hr. course in materials and processing in order that they may aid conservation through knowledge of materials which can be reclaimed.

Reclamation, an important phase of the material conservation program in the Dallas plants, consists of collecting materials which might otherwise be consigned to the scrap heap and preparing them for further use.

Lumber, for example, obtained from shipping cases bringing material to the plants, is cleaned and used again in the crating and shipping departments. The only lumber sold as scrap are those pieces which cannot be re-used in NAA operations.

Drills and screw driver bits are reclaimed by re-sharpening. Hydraulic and other oils are reclaimed through use

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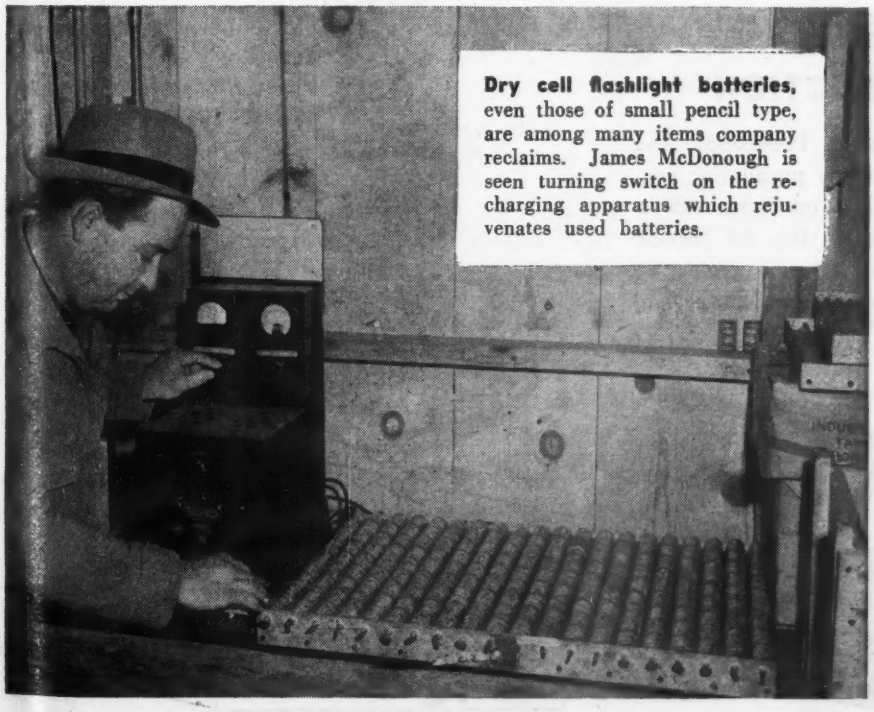

Dry cell flashlight batteries, even those of small pencil type, are among many items company reclaims. James McDonough is seen turning switch on the recharging apparatus which rejuvenates used batteries.

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See specimens of CRAFTINT DRAWINGS in the "Sketch Book of Design Detail", this section of Aviation Magazine.

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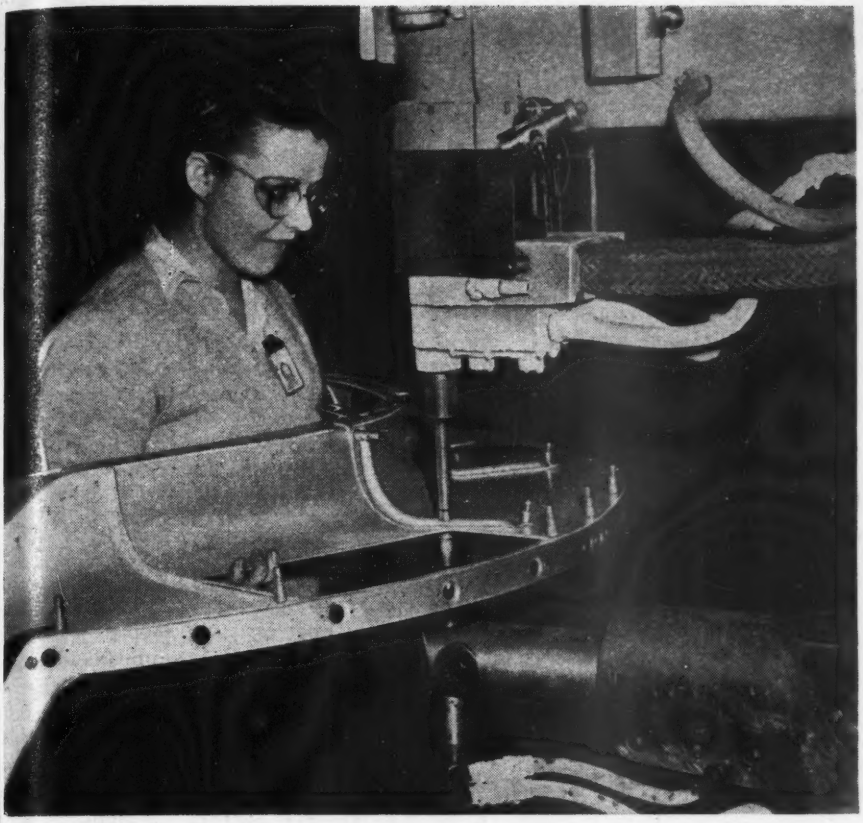


Spotwelding aircraft parts by Frostrode process.

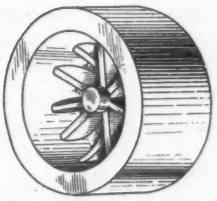
Refrigerated Welding Tips Save Time and Money

SPOT WELDING of the enormous number of small parts required in airplane construction has been speeded up as much as 300 percent by the use of refrigerated electrodes.

Formerly much time was lost in dressing and cleaning the tips of copper electrodes, the trouble being caused by excessive heat generated during the welding process.

At first, refrigeration of the holders and welding arms was tried, with very definite improvement in quality of work and with time saved. Then came the idea of using a hollow tip which would not only be easier to cool but would be more effectively kept at the correct temperature due to the smaller amount of material between the coolant and the source of the heat.

The Frostpoint electrode made by Frostrode Products, Detroit, consists of a permanent shank with a Frostcap hollow, renewable copper point, ribbed on the inside for strength and also to give more cooling surface. Use of internal ribs in the design permits the point to be made considerably thinner, thus bringing the coolant closer to the source of heat.

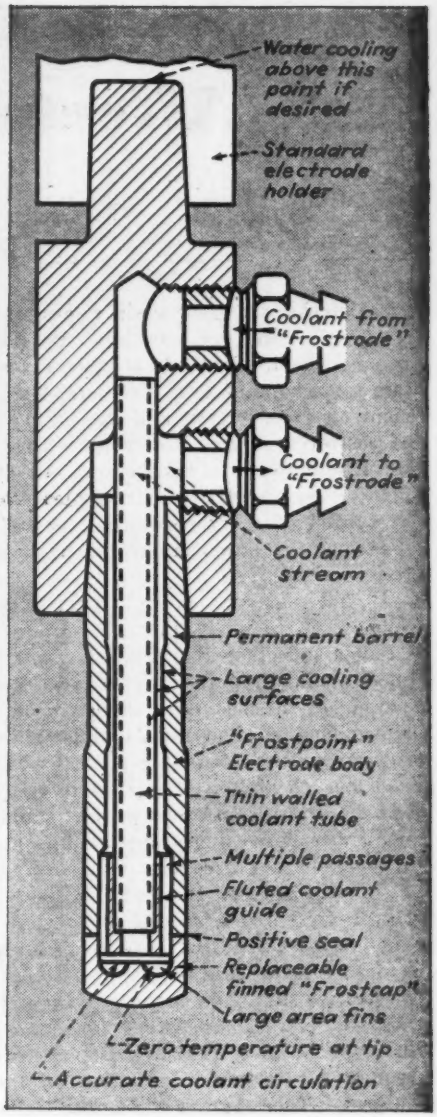


Frostcap electrode cap, showing ribs for strength and cooling.

At a leading aircraft factory, the use of ordinary refrigeration resulted in nearly a 30 percent extension of time between cleaning periods. In another case, it was found that the increase of spots possible between dressings was increased by as much as 150 percent, while on thicker stock—.091 in.—the number of welds was frequently quadrupled before the points required dressing.

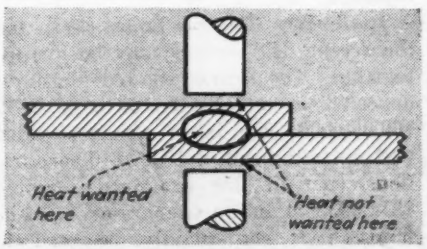
Changing from ordinary to Frostpoint electrodes enabled one of the manufacturers to step up the number of welds between dressings to a rate 300 percent above his best output when using ordinary cooling methods.

The amount of gain apparently differs widely with changes in conditions and materials. Some companies report as high as 15 times as long between dressings while others only claim 50 percent benefit. However, every user claims a distinct saving over the use of ordinary refrigerated electrodes.



Circulation and cooling system of Frostrode electrodes.

Frostpoint electrodes are permanently attached to the machine. The only part requiring removal is the small point. For this purpose, the manufacturer supplies a special electrically heated pliers which expands the point and makes its removal or replacement simple and rapid.



Cross section of Frostrode weld, showing effect of refrigerated electrode.

How Tax Policies Affect Our Industry's Future

By H. L. FEDERMAN

CONGRESS may soon again re-examine the entire tax question. In this process, the aircraft industry may entertain some hope as to more liberal treatment on reconversion and the building of postwar reserves. However, the pending House-approved tax measure largely ignores the aircraft industry's pleas for a revision of the renegotiation procedures and the establishment of postwar reserves.

If and when this entire subject is reopened, it is likely that the aircraft builders and other industrial groups will once again prepare to seek remedial action. In the meantime, there are definite indications that the Administration is preparing to bolster its present position in such matters and plans to resist any major revision of its present stand. A number of seemingly unrelated events all point in this direction.

Not so long ago, the Federal Reserve Board presented a special study showing "business deposits" at a record high. Soon thereafter, the SEC issued a comprehensive survey on corporate war and postwar reserves. This study "originated in response to a Treasury Department request for certain information on the subject." Then there is the authoritative work, *Postwar Expenses Related to Wartime Incomes* issued earlier by the Division of Tax Research, Treasury Department. It is academic to note that the Treasury Department administers the tax laws, but it is a fact worth remembering when studying all of these reports.

Taken in the aggregate, all of this material forms a pattern revealing the official Administration philosophy. All American industry is, of course, affected, and the aircraft group is no exception. But the aircraft builders appear to be hit the hardest by existing regulations. Intelligent action can be taken only after a close analysis of all the factors involved.

The Federal Reserve Board study and the recent SEC survey may be lumped together. The former showed "business deposits" at an all-time peak of $38,700,000,000. The latter report revealed that up to the end of 1942, 146 corporations (out of 250 examined) created $514,593,000 in postwar reserves. The implications can plainly be read to mean that industry is capable of financing its own reconversion program and therefore existing tax policies need not be changed.

The figures advanced are imposing but contain a number of fundamental fallacies. In the first place, the companies having the greatest burden in adjusting to peace activities do not necessarily have the reserves. Secondly, while the SEC data is enlightening, in some respects it must remain meaningless until some reliable estimates may be made regarding the cost of reconversion and attendant postwar commitments.

Neither the Federal Reserve or SEC study discloses any specific data for the aircraft industry—the group with the greatest postwar uncertainties. The five largest companies in each of the basic 50 industries are used in the SEC survey. Selections were based on the prewar activities of the corporations, presumably 1939. By this process, the aircraft industry did not even get its foot in the door.

Nevertheless, for proper perspective it may be interesting to note the earnings recorded by leading American industrials for the four year period of 1939-1942 inclusive, as taken from the SEC data and as compared with similar results established by representative aircraft companies and as reported by the statistical services.

TABLE I

NET INCOME TRANSFERRED TO SURPLUS*

*(Selected American industrials as compared with representative aircraft companies, 1939-1942 inclusive)***

	Amount in Millions
GENERAL INDUSTRIALS	
General Motors Corp.	$809.8
E. I. duPont de Nemours & Co.	359.5
American Tobacco Co.	90.4
General Electric Co.	216.8
Westinghouse Electric Co.	80.2
Sears, Roebuck & Co.	140.2
Anaconda Copper Mining Co.	135.2
Standard Oil Company, N. J.	443.9
Socony-Vaccum Oil Co.	159.2
United States Steel Corp.	381.3
AIRCRAFT	
Boeing Airplane Co.	$14.4
Consolidated Vultee Corp.	28.9
Curtiss-Wright Corp.	67.8
Douglas Aircraft Co.	48.2
Glenn L. Martin Co.	24.9
United Aircraft Corp.	65.2

NOTES: * As adjusted by adding back reserve provisions charged against income.
** Years shown are either for the calendar or fiscal period, but in all cases a four-year term is covered.

SOURCES: *Corporate War & Postwar Reserves, SEC; Standard & Poor's Aircraft Industry Survey;* and Moody's *Industrial Manual.*

This is done herewith in Table 1. Net earnings are used, since reserves do not tell the complete story. Regardless of how labeled, if a company has a backlog of earnings—and has not paid all of it out in dividends—a nest-egg is available for postwar purposes. It is, of course, essential to know if these reserves and surplus accounts are represented by cash or fixed plant. This, in itself, is a vital distinction.

In any event, the accompanying table is helpful because it does show which companies derived the most benefit from war activity. Using this measure, the aircraft industry is far removed from being the country's leading "war baby"—as it is popularly supposed to be.

Of far greater significance is the fact that those industrials whose transition back to a peacetime economy will represent no major problem, have the "business deposits" and "reserves" which the government surveys highlight. The aircraft group, despite war-inflated activity, has never been able to accumulate as much of an earnings backlog to be in the same league with other major industrial enterprises. For example, Curtiss-Wright, which shows the largest aggregate earnings for the four year period examined, is dwarfed by every non-aviation entity presented in the table. Many more companies not shown also have impressive earnings backgrounds which makes those of the aviation business appear rather picayune.

The Treasury Department's treatment of reserves and postwar expenses related to wartime income is not merely a useful guide to the aircraft group but can also suggest where corrective action may be directed.

The Treasury recognizes that since Federal taxes under the present law may take up to 80 percent of a corporation's net income, the nondeductibility of reserves which provide for costs related to the war not only overstates wartime income but limits the ability of business firms to create such reserves. Accordingly, advocates of postwar reserves urge the allowance of such reserves as a deduction from taxable income.

In other words, instead of trying to correct the renegotiation processes, it would be far more desirable and effective to concentrate on the tax elements. Yet, this is not generally appreciated. Thus, in the hearings before the House Ways & Means Committee last September, the aircraft industry emphasized the effects renegotiation was having on its working capital and financial condi-

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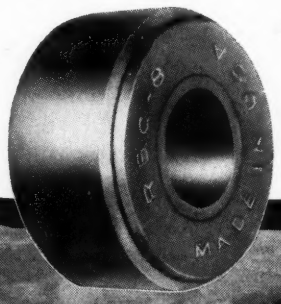

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tion, and in support of its views, studies of the Harvard Business School were introduced.

While it is true the aircraft builders were hit hard by renegotiated contracts, there is a fundamental fallacy to the approach used. As has been previously indicated, the tax rate is so high that, as a practical matter, of every dollar renegotiated, only about 20 to 30c on the average comes from earnings. In other words, were earnings not reduced by renegotiation, a substantial portion would have, in any event, been recaptured by excess profits taxes.

There are a number of examples at hand to provide ample substance to this assertion. During 1942, Boeing refunded about $34,300,000 through renegotiation. However, Boeing's Pres. Johnson observed that "if the refunds were not made, approximately 80 percent (of the refund) would have been returned to the government through taxes." More recently, Bell Aircraft completed its 1942 renegotiation of contracts. The company announced that $8,900,000, before taxes, is being returned to the government. However, after taxes, the net effect on earnings would be only about $1,163,180.

It is also of interest to note that this amount was more than covered by the $1,200,000 reserve for contingencies set up out of 1943 earnings, although the management did not choose to charge the renegotiations against this reserve, but against earned surplus. For all practical purposes, this difference is merely a bookkeeping one, since earnings remain unchanged (before reserves but not including $1,800,000 postwar rebate) at $11.78 a share, as reported on the 356,750 shares outstanding at the end of 1942.

Incidentally, Bell is now reported operating mainly on a fixed fee for its airplane contracts, and although the margin of profit is smaller than on price work, the volume has increased considerably. Ordnance work is also on a fixed price basis. On an over-all basis, close observers believe Bell may be able to earn about as much in 1943 as in 1942, before reserves and refunds.

All down the line, similar conditions may be found to pertain, in varying degree, for every major aircraft company. This simply suggests that it is futile to attempt to improve the renegotiation processes. Instead, the frontal approach should be directed at the tax laws and their effect on the aircraft industry's future.

The frequent assertions advanced by government agencies that the Treasury is constantly "saving billions through renegotiation," is a good deal of hokum. Substantially, all of these savings would, in any event, have been siphoned off through taxes. However, there is a disinclination to overlook the confusion—the huge waste in manpower caused by negotiators constantly poring over books and harassing industry by repeated recapture attempts on the same contracts. The direct tax approach would center control and regulation of earnings in one government agency—the Treasury Department.

Treasury's Position

In its tax discussion, the Treasury examines in some detail the various elements it considers as proper charges to wartime income, and the aircraft industry can profit by a close study of these factors.

The Treasury attacks the attempt to make the deduction of surplus reserves from wartime income tax-free. It disputes the contentions that taxes on wartime income are so high as to endanger the financial stability of enterprise and that the accumulation of tax-free surplus reserves will make possible large employment creating expenditures and capital outlays by business in the postwar period. The question is raised of subsidizing capital expansion through tax remission. The point is made that, ordinarily, new capital has been secured from reinvested earnings or the capital markets and not from subsidies, except "in special instances for reasons of broad public policy."

The Treasury does not answer the aircraft group's claim of "profitless prosperity." Also ignored is the fact that new capital is unlikely to flow into an industry that is faced with much future uncertainty and beset with present tax pressures. Furthermore, if the maintenance of a strong aircraft industry is not good "public policy", then what other industry has a better claim?

Discussion centering around the types of expenditures for which postwar reserves may be provided, promises to hold some hope for the aircraft builders.

Need for dismissal payments is recognized as arising from the enormous war expansion many firms have undergone. It is asserted that "since it represents a payment directly connected with the activities of the war firm in earning wartime income and for which no postwar services will be rendered, in an accounting sense it constitutes a charge against wartime income."

While abnormal maintenance expenditures are considered as proper deductions, it is unlikely that this element will figure very prominently in the aircraft group's future problems.

Reconversion costs come in for attention and are particularly pertinent. It is maintained that if these costs "are connected with the return of plants to their prewar status, they would be allocated, in accounting principle, against wartime income. In order to earn wartime income, costs had to be incurred for conversion to war work, and costs will also have to be incurred to return to peacetime production. . . . The case is doubtful, however, if Government-owned or amortized facilities are involved, or if reconversion necessitates purchase of new plant and equipment."

Losses resulting from cancellation of war contracts are given their due. It is recognized that any such losses having arisen in connection with the firm's war production, would represent proper deductions from income earned under war contracts.

Inventory losses due to declines in

(*Turn to page* 334)

TABLE II—OPERATION OF CARRY-BACKS FOR INDIVIDUAL CORPORATIONS

(Classified by peacetime product and by type of postwar cost, in millions of dollars)

Corporation	Approximate base for the carry-back [a]	Items bearing on the magnitude of postwar losses					Maximum Amount of refund [d]	
		Company's estimate of postwar costs [b]	Inventories 1942	Net plant 1942	Cost sales 1942	Amount of dismissal compensation [c]	Income tax	Excess-Profits tax
Contract-cancellation losses and dismissal compensation								
1. Aircraft, Co. A....	$74.2	7.8 Adjustment of plant and personnel on termination and development costs	$52.2	$15.6	$351.2	Not avail.	$1.6	$51.4
2. Aircraft, Co. B....	115.0	4.0 Postwar readjustment	96.7	7.7	245.2	12.8	10.4	75.0
3. Aircraft, Co. C....	213.0	24.2 Postwar readjustment	289.5	28.0	669.5	Not avail.	8.8	143.8
4. Aircraft, Co. D...	140.2	12.7 Contingencies	38.7	19.0	376.6	Not avail.	3.6	101.8

[a] Net income before taxes in 1942, plus an assumed income in 1943 equal to 1942.
[b] Accumulated reserves through 1942.
[c] Assuming $150 (approximately one month's salary) is paid to employees in 1942 in excess of employment in 1939.
[d] Estimated taxes in 1942 and 1943.
[e] As stated before House Naval Affairs Committee in hearings on renegotiation of contracts.
SOURCES: Moody's *Industrials & Public Utilities;* and Division of Tax Research, Treasury Department, Oct. 1943.

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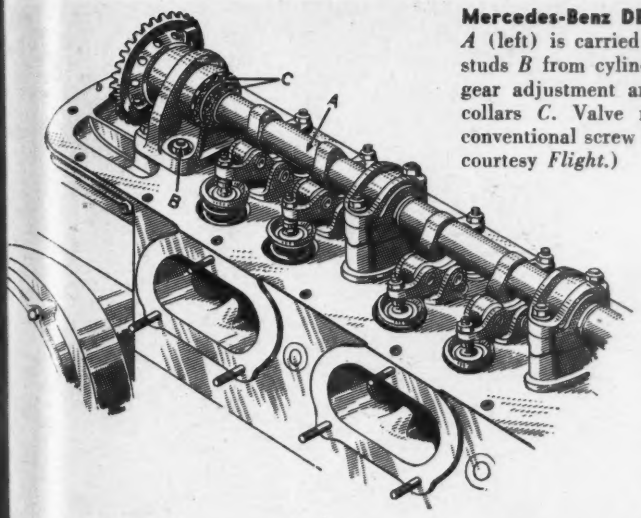
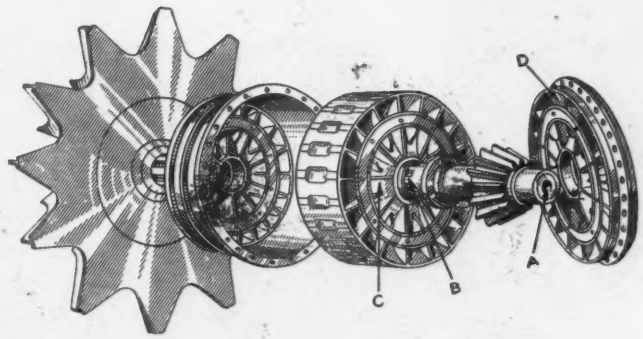
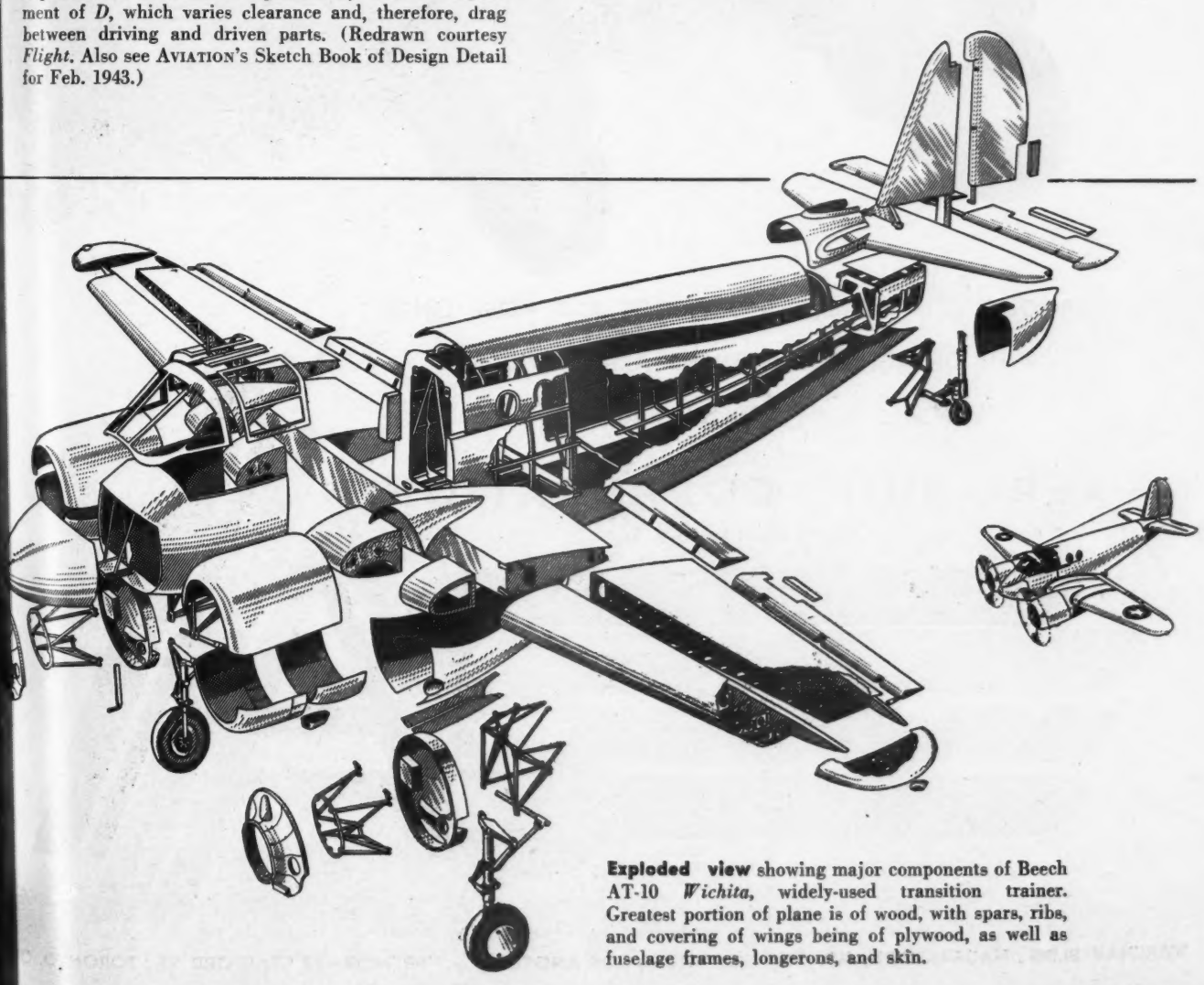


Mercedes-Benz DB-601 engine camshaft *A* (left) is carried on bearings secured by studs *B* from cylinder head. End play and gear adjustment are handled by threaded collars *C*. Valve rocker adjustments are conventional screw and nut type. (Redrawn courtesy *Flight*.)



Fluid coupling supercharger drive major components of Mercedes-Benz DB-601 (right) include driving portion *C* which is mounted on shaft by splines *B*. This assembly is engine-driven through bevel gear. Outer, or driven section, is in two parts, cover *D* being provided with bearing in which shaft turns. Oil under pressure is provided by engine driven pump through hollow shaft *A*. Unit *C* is free to float endwise in outer casing, and slip between sections is regulated by endwise adjustment of *D*, which varies clearance and, therefore, drag between driving and driven parts. (Redrawn courtesy *Flight*. Also see AVIATION's Sketch Book of Design Detail for Feb. 1943.)



Exploded view showing major components of Beech AT-10 *Wichita*, widely-used transition trainer. Greatest portion of plane is of wood, with spars, ribs, and covering of wings being of plywood, as well as fuselage frames, longerons, and skin.

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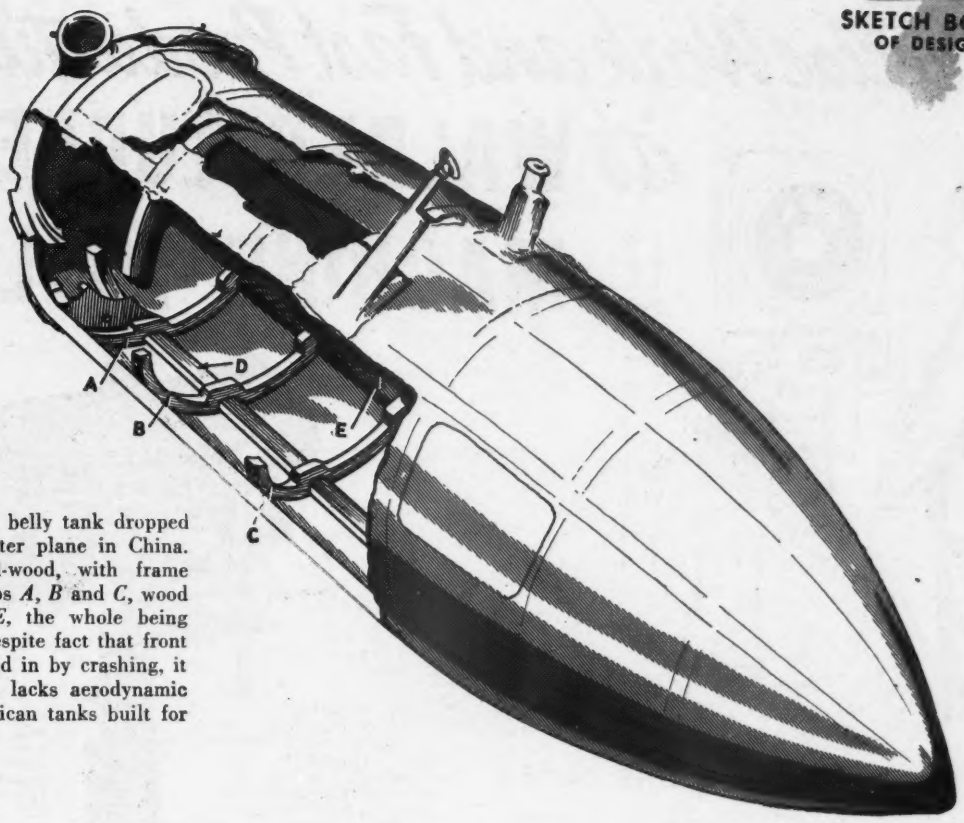
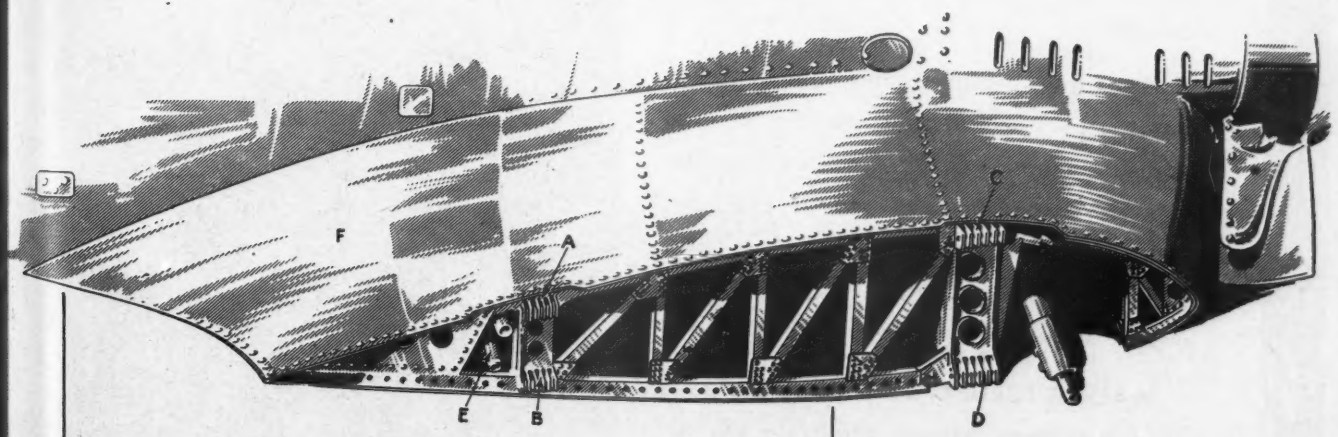


Cut-away view of belly tank dropped from Jap *Zero* fighter plane in China. Construction is all-wood, with frame built up of wood ribs *A*, *B* and *C*, wood longerons *D* and *E*, the whole being plywood-covered. Despite fact that front end had been bashed in by crashing, it was seen that tank lacks aerodynamic cleanliness of American tanks built for same purpose.



Outer wing panel of Italian Macchi 200 fighter plane attaches to center section (right side of which is shown here) by bolts through four attaching points shown at *A*, *B*, *C* and *D*. Center section is conventional truss, with built up rib between spars, front of which is at right. Control connection is at *E*, just aft of rear spar. *F* is fairing between fuselage and outer end of center section.

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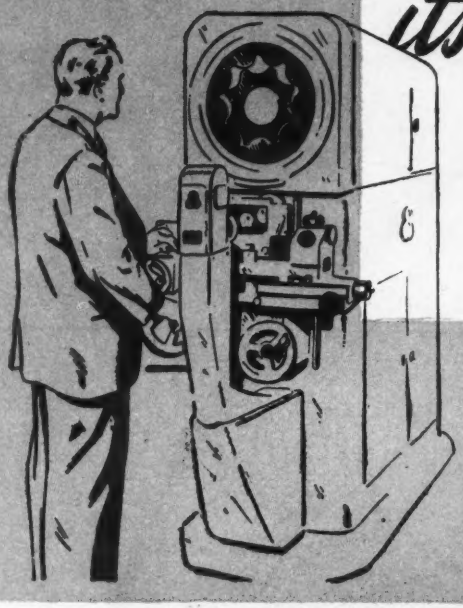

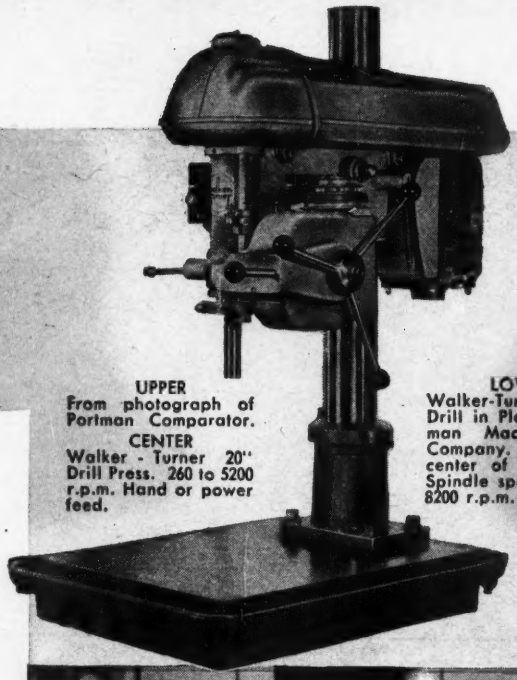

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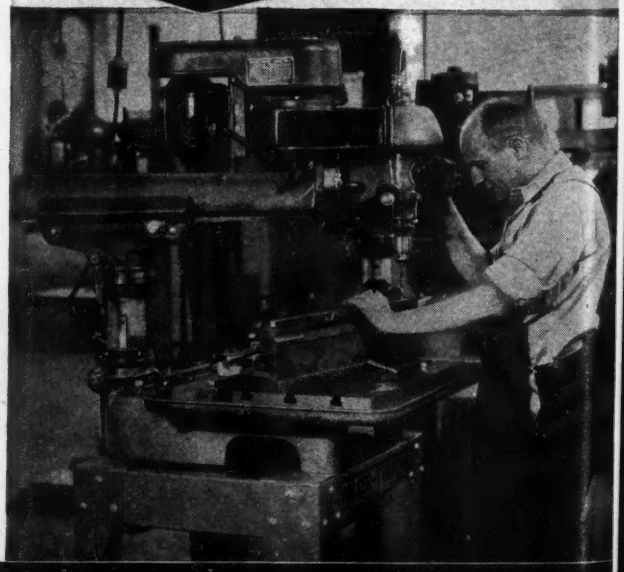

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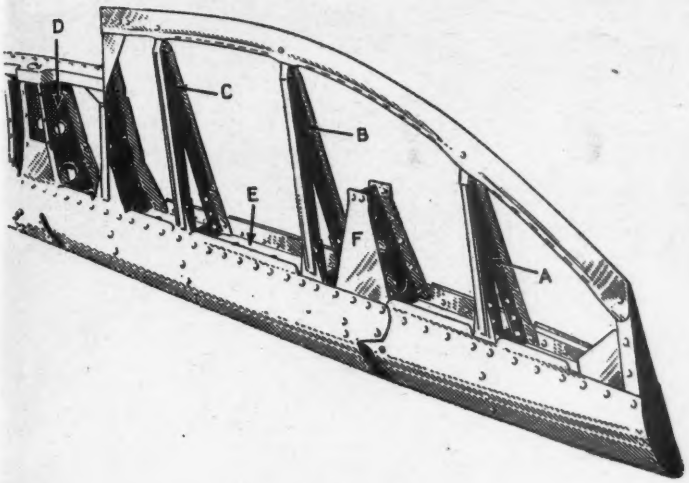
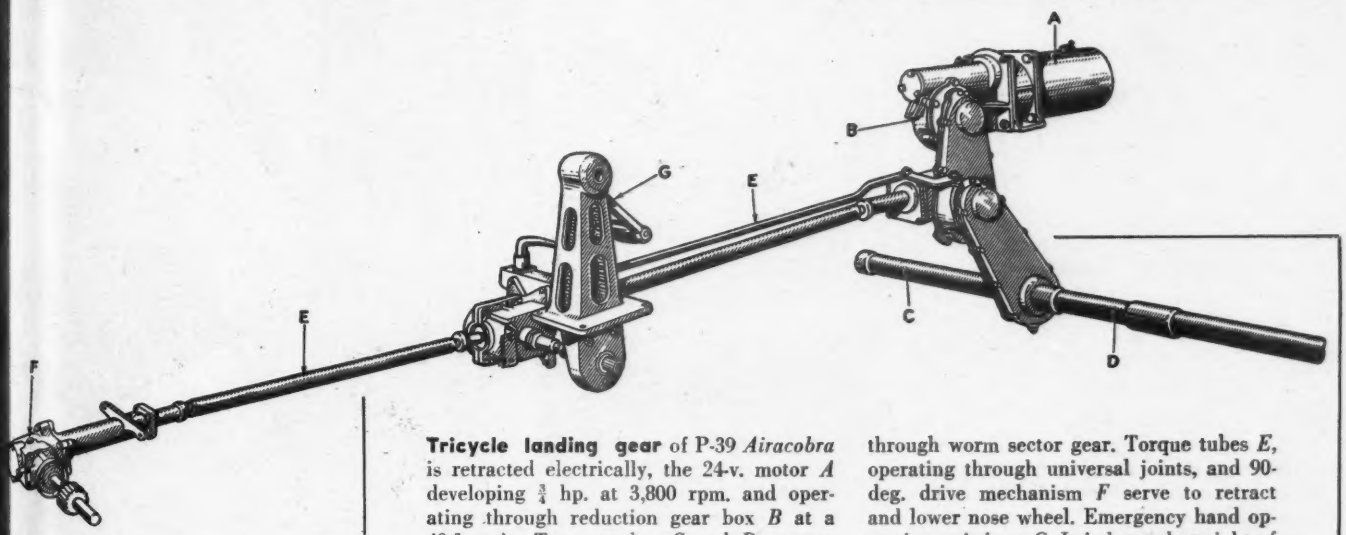
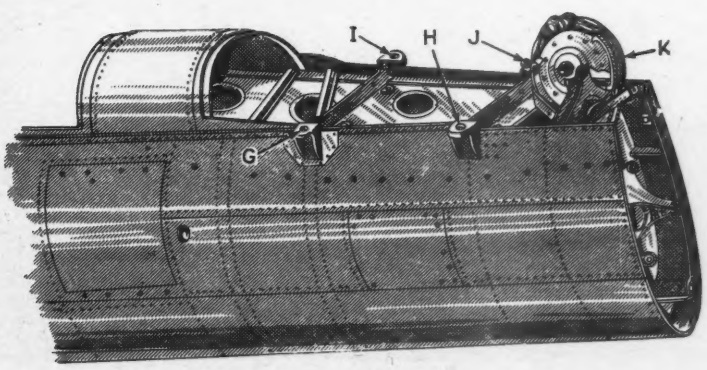


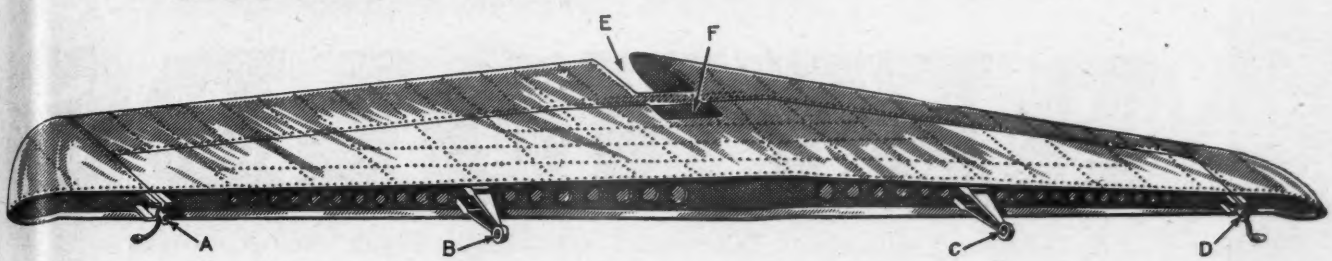
Bell P-39 Airacobra Frise-type ailerons have both built-up ribs of extruded shapes, as shown at *A*, *B*, and *C*, and formed ribs as at *D*, attached to monospar *E*. Aileron hinge housing *F* is built up of flat sheets riveted to formed members.

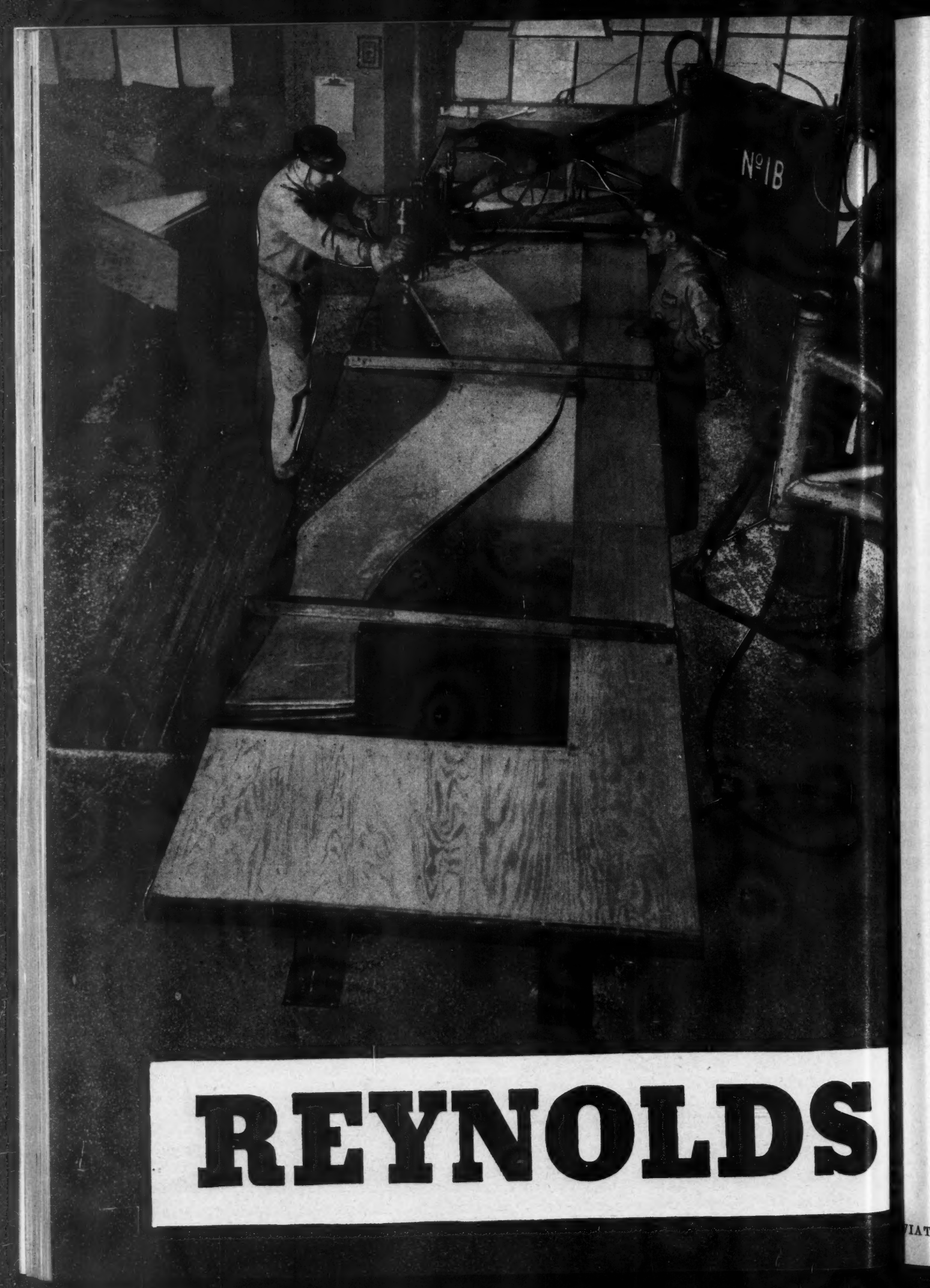


Tricycle landing gear of P-39 *Airacobra* is retracted electrically, the 24-v. motor *A* developing ¾ hp. at 3,800 rpm. and operating through reduction gear box *B* at a 40-1 ratio. Torque tubes *C* and *D* operate right and left main wheel, respectively, through worm sector gear. Torque tubes *E*, operating through universal joints, and 90-deg. drive mechanism *F* serve to retract and lower nose wheel. Emergency hand operation unit is at *G*. It is located at right of pilot's seat.



Horizontal stabilizer of *Airacobra* (below) is designed for construction as single unit. It consists of channel shape front spar, leading edge formers, longitudinal ribs, transverse stringers, and flush-riveted stressed skin. Elevator attaches to four hinge fittings at *A*, *B*, *C*, and *D* on rear spar. Stabilizer is cut away in two places, *E* and *F*, to permit access of vertical stabilizer to fuselage. Horizontal stabilizer attaches to aft fuselage by four threaded studs, shown on fuselage detail (left) at *G*, *H*, *I*, and *J*. *K* is elevator control quadrant, with control cables coming up from fuselage.

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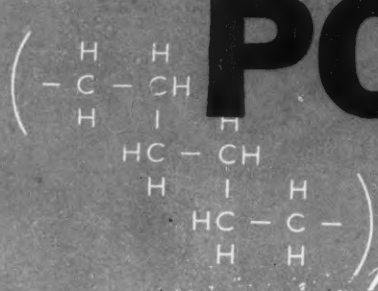
ANNOUNCING A NEW PLASTIC BY DU PONT

POLYTHENE



—CURRENTLY FOR WAR PURPOSES

Light in weight, extremely low in water absorption and moisture permeability, exceptional electrical properties

Now—after five years of intensive experimentation and development work—Du Pont announces polythene.* This is a new and unique plastic suitable for a wide variety of applications. Developed by Du Pont under basic U.S. product and process patents (U.S.P. 2153553 and 2188465)—exclusive rights to which are owned by Du Pont—polythene is in production to meet certain war needs.

Several distinct advantages indicate the use of polythene for many applications long considered the proper sphere of plastics but impossible with materials available up to now. Note these special properties:

LOW WATER ABSORPTION—not more than 0.075% (A.S.T.M. method D 570-42). Water vapor transmission —0.4 grams per square meter per 24 hours at 25°C, 0.004" thickness (A.S.T.M. method D697-42T).

HIGH DIELECTRIC STRENGTH—1000 v/mil at 0.01" thickness, dielectric constant 2.2—2.3, with a power factor of less than .0005 over a wide range of frequencies.

VERY LOW SPECIFIC GRAVITY—0.92—0.93.

UNUSUAL LOW-TEMPERATURE FLEXIBILITY.

REMARKABLE CHEMICAL INERTNESS—resistant to water, alkalies, acids, and oxygenated solvents.

READY MOLDING AND FABRICATION BY PRESENT METHODS—with existing thermoplastic molding and shaping equipment. Polythene powder can be extruded, injection molded, compression molded and calendered. In sheet, rod or tube form it can be machined, cut, blown, blanked or swaged.

ADDITIONAL FACTS ABOUT DU PONT POLYTHENE—In stiffness, polythene lies between the so-called rigid and non-rigid types of plastics. Its tensile strength is 1500 psi. It is slow burning. It is soluble in hot aliphatic, aromatic, or chlorinated hydrocarbon solvents.

WIRE AND CABLE COVERING—the remarkable electrical properties and ease of extrusion of Du Pont polythene indicate wide usage in this field.

NOW AVAILABLE—polythene is available now in production quantities only by specific authorization through WPB order M-348. However, small lots for experimental purposes may be secured on proper application. Write for polythene properties chart and other data which will suggest to you ways in which you might take best advantage of the unusual qualities of this new plastic for war work. Address inquiries to E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, New Jersey.

**A generic name for a solid, tough polymer from ethylene*

DU PONT PLASTICS

An ever-growing family whose newest member is polythene

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING...*THROUGH CHEMISTRY*

Application, Properties, and Cost Of Controlled Atmospheres for Heat Treating

Composition And Cost Of Typical Controlled Atmospheres

Description	Nature of Atmosphere	Atmosphere	Air-to-Gas Ratio	N_2	H_2	CO	CO_2	CH_4	O_2	Dew Point	Gas for M Cu. Ft. Atmosphere	Cost Per Atmosphere
Completely reacted fuel.. (Auxiliary heat needed)	Combustible; toxic; most reducing	Endogas	2.75:1 *a*	41.7	38.0	19.0	0.0	1.3	0.0	−10°F.	200 *c*	$0.18 to 0.25 *e*
Completely burned fuel..	Noncombustible; slightly reducing	Lean Exogas	10:1 *a*	89.0	0.5	0.5	10.0	0.0	0.0	*b*	115 *c*	0.08 *d*
Partially cracked fuel.... (Self-propelled)	Combustible; toxic; medium reducing	Rich Exogas	6:1 *a*	69.0	15.0	10.0	5.0	1.0	0.0	*b*	145 *c*	0.10 *d*
Lean Exogas scrubbed of CO_2 and H_2	Noncombustible; inert	Lean Monogas	10:1 *a*	94.0	3.0	3.0	0.0	0.0	0.0	−50°F.	125 *c*	0.20 to 0.40 *e*
Rich Exogas scrubbed of CO_2 and H_2	Combustible; toxic; reducing	Rich Monogas	6:1 *a*	72.0	16.0	11.0	0.0	1.0	0.0	−50°F.	150 *c*	0.22 to 0.42 *e*
Dissociated ammonia....	Combustible; reducing	Ammogas	No air	25.0	75.0	0.0	0.0	0.0	0.0	−60°F.	22.2lb. NH_3	2.00 to 4.00 *f*
Ammogas completely burned	Noncombustible; inert	Lean Ammogas	1.88:1 *g*	99.0	1.0	0.0	0.0	0.0	0.0	*b*	13.7lb. NH_3	1.20 to 2.40 *f*
Ammogas partially burned	Combustible; slightly reducing	Rich Ammogas	1.25:1 *g*	80.0	20.0	0.0	0.0	0.0	0.0	*b*	14.9lb. NH_3	1.30 to 2.60 *f*

a Air-to-gas ratios are representative for natural gas containing practically nothing but methane. For high hydrogen city gas, ratios are about 50 percent of values given; for city gas with medium hydrogen and high CO, ratios are about 40 percent of values given. For propane, ratios are approximately twice the values given in the table, and for butane about three times.

b Dew points correspond to room temperatures unless auxiliary drying equipment is added. Dew point may be reduced to 40 deg. F. by simple refrigeration equipment; to minus 50 deg. F. or less by use of absorbent towers.

c Values are in cu. ft. for high methane natural gas. For various types of manufactured city gas, double the value given. For propane, requirements are half of values given, and for butane one third.

d Costs figured on raw natural gas at 50c. per M cu. ft., electricity at 1c. per kwh., water at 5c. per M gal. Use of city gas usually doubles the cost figures given.

e Low value when reactivating moisture absorbent with steam; high value when using electrical heat.

f Costs based on 7c. per lb. NH_3 in tank car lots and 15c. per lb. for cylinder quantities. Electricity for dissociation at 1c. per kwh.

g Dissociated ammonia.

Data Supplied by C. E. Peck, Heat Treating Engineer, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Helping to Keep the "line" Open!

The numerous spark plugs in war service engines release a barrage of miniature (but very noisy) thunder claps. Unless well by-passed, these crashes would block the operator's phones.

Scientifically designed Bolton Shielded Ignition Assemblies are used on war plane, tank and boat engines to "drain" off a maximum of this interference and keep the "line" open. To insure long, uninterrupted service amid the impact of modern combat, these Assemblies are of extremely rugged construction.

BOLTON *SHIELDED* IGNITION ASSEMBLIES

BOLTON MANUFACTURING CORPORATION

692 CAMPBELL AVENUE · WEST HAVEN · CONNECTICUT

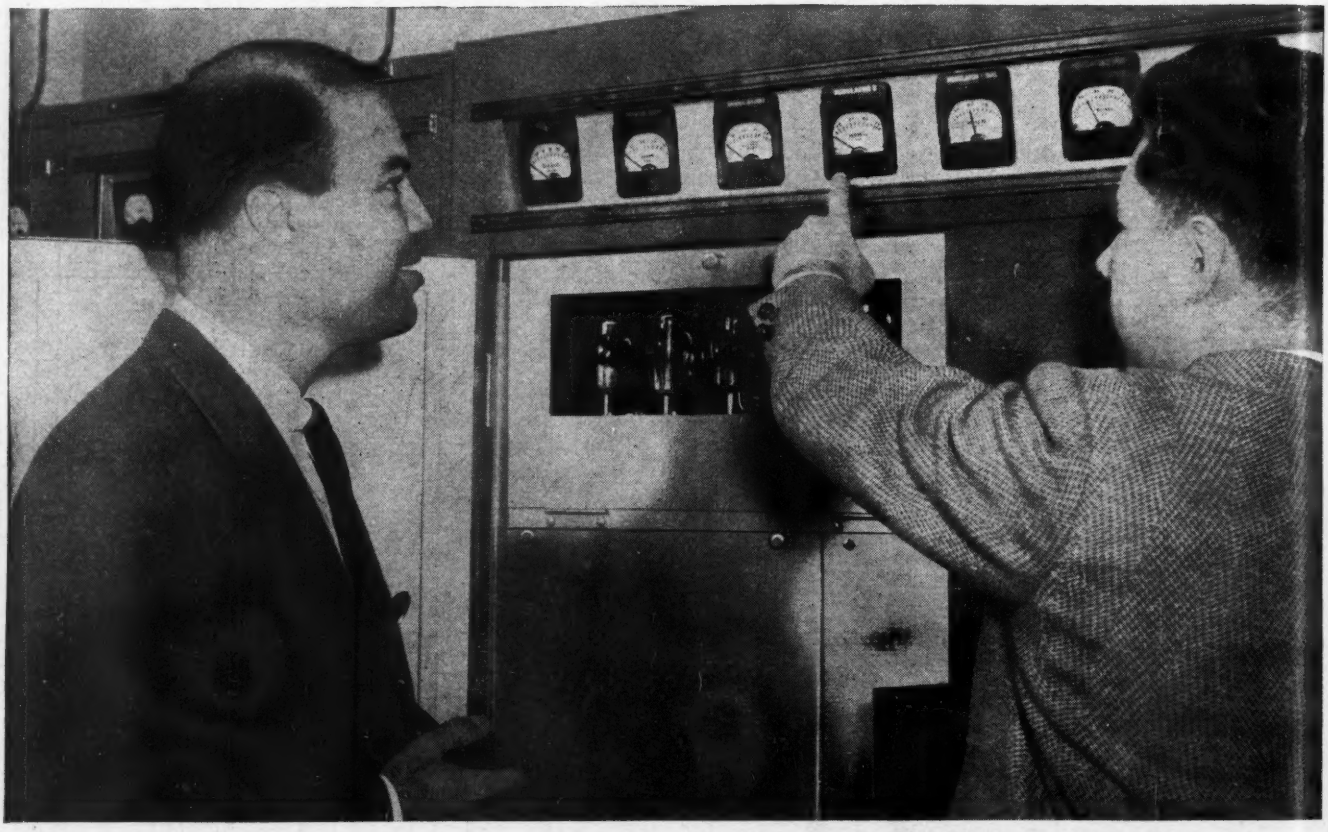
Atmospheres Suitable for Heat Treatment of Different Metals

Heat Treatment	Metal Processed	Process	Temperature Range, °F.	Time Cycle (Long—if Over 2 Hr.)	Required Surface	Recommended Atmosphere
Annealing	Low carbon steels	Anneal	1,200 to 1,350	Long	Bright	Rich Exogas
	Medium and high carbon steels	Anneal (no decarburization)	1,200 to 1,450	Long	Bright	Monogas
	Alloy steels, medium and high carbon	Anneal (no decarburization)	1,300 to 1,600	Long	Bright or clean	Monogas
	High speed tool steels including molybdenum high speeds	Anneal (no decarburization)	1,400 to 1,600	Long	Bright or clean	Monogas
	Stainless steels, chromium and nickel-chromium	Anneal	1,800 to 2,100	Long or short	Bright	Ammogas
	Copper	Anneal	400 to 1,200	Long or short	Bright	Lean Exogas
	Various brasses	Anneal	800 to 1,350	Long or short	Clean	Lean Exogas
	Copper-nickel alloys	Anneal	800 to 1,400	Long or short	Bright	Rich Exogas
	Silicon-copper alloys	Anneal	1,200 to 1,400	Long or short	Bright	Lean Monogas
Brazing or Soldering operations	Low carbon steels	Copper brazing	2,050	Short	Bright	Rich Exogas
	Medium, high carbon and alloy steels	Copper brazing (no decarburization)	2,050	Short	Bright	Endogas
	Medium, high carbon and alloy steels	Copper brazing (no decarburization)	2,050	Long	Bright	Monogas
	High carbon, high chromium steels	Copper brazing (no decarburization)	2,050	Short	Bright	Ammogas
	Stainless Steels	Copper brazing	2,050	Short	Bright	Ammogas
	Copper or brass	Phos-Copper brazing or silver soldering	1,200 to 1,600	Short	Bright	Lean Exogas
Hardening	Medium and high carbon steels	Hardening (no decarburization	1,400 to 1,800	Short	Bright or clean	Endogas
	Alloy steels, medium and high carbon	Hardening (no decarburization)	1,400 to 1,800	Short	Bright or clean	Endogas
	High-speed tool steels including molybdenum	Hardening (no decarburization)	1,800 to 2,400	Short	Bright or clean	Endogas
Tempering	All classes of ferrous metals	Tempering or drawing	400 to 1,200	Short	Bright or clean	Exogas*
Gas Carburizing	Carburizing steels	Gas carburizing	1,400 to 1,800	Long	Clean	Endogas (as a carrier)
Sintering of Metals	Low carbon ferrous metals	Reduction and sintering	1,800 to 2,050	Short	Bright or clean	Endogas
	High carbon and alloy ferrous metals	Reduction and sintering	1,800 to 2,050	Short	Bright or clean	Endogas
	Nonferrous metals	Reduction and sintering	1,400 to 1,800	Short	Bright or clean	Endogas
Normalizing	Low carbon steels	Normalizing	1,600 to 1,850	Short	Bright or clean	Rich Exogas
	High carbon and alloy steels	Normalizing (no decarburization)	1,500 to 2,000	Short	Bright or clean	Monogas

* Whether rich or lean depends upon individual applications.

WILCOX IS IN SERVICE

...Along the Route of The Capital Fleet



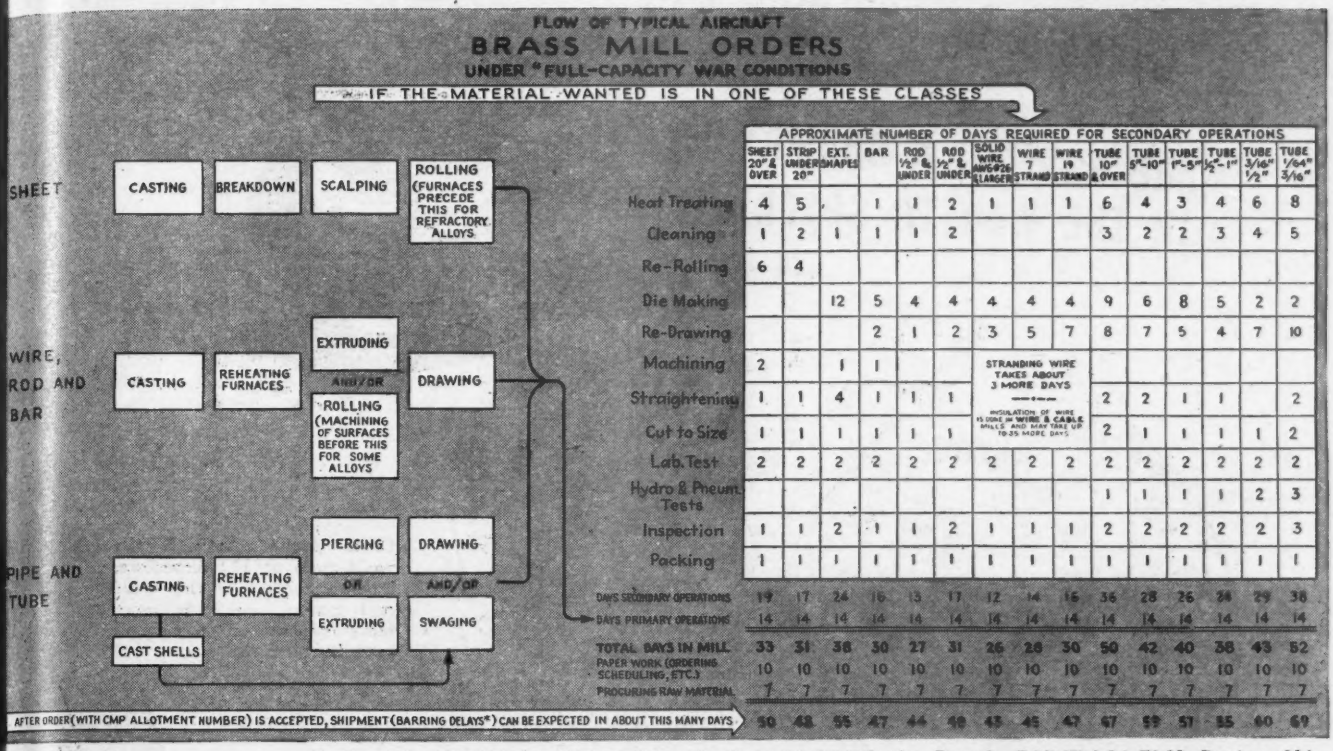
Photograph, courtesy PENNSYLVANIA-CENTRAL AIRLINES,
(left) B. J. Vierling, Supt., Maintenance, (right) Earl Raymond, Chief, Ground Station Maintenance.

"Installation of Wilcox transmitters, at many of our points, has given our communications the high degree of dependability so necessary for airline operations," states Mr. Earl Raymond of Pennsylvania-Central Airlines. In addition to installations on major airlines throughout the United States, Wilcox radio equipment is being used now in connection with world-wide military aircraft operations.

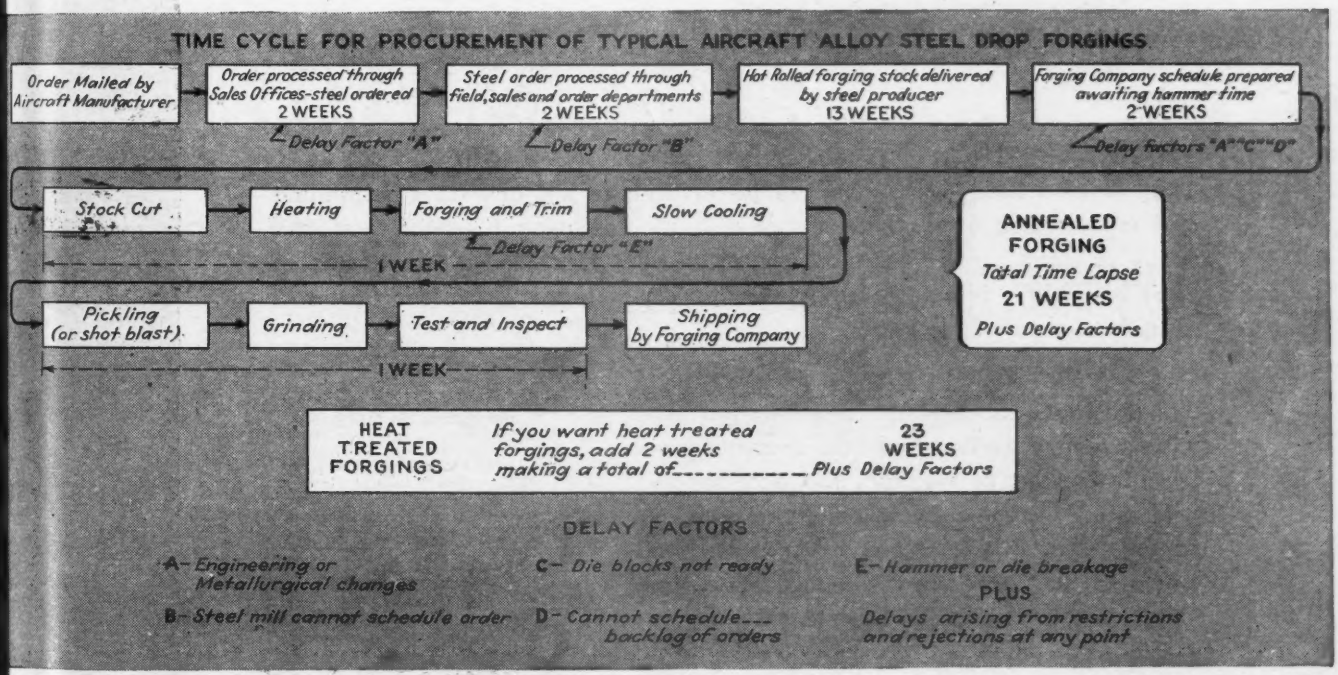
WILCOX ELECTRIC COMPANY

MANUFACTURERS OF RADIO EQUIPMENT • FOURTEENTH & CHESTNUT, KANSAS CITY, MO.

Time Lag On Materials Orders


FLOW OF TYPICAL AIRCRAFT
BRASS MILL ORDERS
UNDER "FULL-CAPACITY WAR CONDITIONS
IF THE MATERIAL WANTED IS IN ONE OF THESE CLASSES
SHEET
CASTING
BREAKDOWN
SCALPING
ROLLING (FURNACES PRECEDE THIS FOR REFRACTORY ALLOYS
WIRE, ROD AND BAR
CASTING
REHEATING FURNACES
EXTRUDING
AND/OR
ROLLING (MACHINING OF SURFACES BEFORE THIS FOR SOME ALLOYS
DRAWING
PIPE AND TUBE
CASTING
REHEATING FURNACES
PIERCING
OR
EXTRUDING
DRAWING
AND/OR
SWAGING
CAST SHELLS
APPROXIMATE NUMBER OF DAYS REQUIRED FOR SECONDARY OPERATIONS
SHEET 20" & OVER
STRIP UNDER 20"
EXT. SHAPES
BAR
ROD ½" & UNDER
ROD ½" & UNDER
SOLID WIRE AWG #26 & LARGER
WIRE 7 STRAND
WIRE 19 STRAND
TUBE 10" & OVER
TUBE 5"-10"
TUBE 1"-5"
TUBE ½"-1"
TUBE 3/16" ½"
TUBE 1/64" 3/16"
Heat Treating 4 5 1 1 2 1 1 1 6 4 3 4 6 8
Cleaning 1 2 1 1 1 2 3 2 2 3 4 5
Re-Rolling 6 4
Die Making 12 5 4 4 4 4 4 9 6 8 5 2 2
Re-Drawing 2 1 2 3 5 7 8 7 5 4 7 10
Machining 2 1 1
Straightening 1 1 4 1 1 1 2 2 1 1 2
Cut to Size 1 1 1 1 1 1 2 1 1 1 1 2
Lab. Test 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
Hydro & Pneum. Tests 1 1 1 1 2 3
Inspection 1 1 2 1 1 2 1 1 1 2 2 2 2 2 3
Packing 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
STRANDING WIRE TAKES ABOUT 3 MORE DAYS
INSULATION OF WIRE IS DONE IN WIRE & CABLE MILLS AND MAY TAKE UP TO 25 MORE DAYS
DAYS SECONDARY OPERATIONS 19 17 24 16 13 17 12 14 16 36 28 26 24 29 38
DAYS PRIMARY OPERATIONS 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14
TOTAL DAYS IN MILL 33 31 38 30 27 31 26 28 30 50 42 40 38 43 52
PAPER WORK (ORDERING SCHEDULING, ETC.) 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
PROCURING RAW MATERIAL 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
AFTER ORDER (WITH CMP ALLOTMENT NUMBER) IS ACCEPTED, SHIPMENT (BARRING DELAYS*) CAN BE EXPECTED IN ABOUT THIS MANY DAYS 50 48 55 47 44 48 45 45 47 67 59 51 55 60 69

Produced by Non-Ferrous Metals Sub-unit, Material Distribution Branch, RCS Wright Field, Dayton, Ohio.


TIME CYCLE FOR PROCUREMENT OF TYPICAL AIRCRAFT ALLOY STEEL DROP FORGINGS
Order Mailed by Aircraft Manufacturer
Order processed through Sales Offices-steel ordered 2 WEEKS
Delay Factor "A"
Steel order processed through field, sales and order departments 2 WEEKS
Delay Factor "B"
Hot Rolled forging stock delivered by steel producer 13 WEEKS
Forging Company schedule prepared awaiting hammer time 2 WEEKS
Delay factors "A" "C" "D"
Stock Cut
Heating
Forging and Trim
Slow Cooling
Delay Factor "E"
1 WEEK
Pickling (or shot blast)
Grinding
Test and Inspect
Shipping by Forging Company
1 WEEK
ANNEALED FORGING
Total Time Lapse
21 WEEKS
Plus Delay Factors
HEAT TREATED FORGINGS
If you want heat treated forgings, add 2 weeks making a total of
23 WEEKS
Plus Delay Factors
DELAY FACTORS
A- Engineering or Metallurgical changes
B- Steel mill cannot schedule order
C- Die blocks not ready
D- Cannot schedule— backlog of orders
E- Hammer or die breakage
PLUS
Delays arising from restrictions and rejections at any point

Prepared by Metals Distribution Branch, Resources Control Section, Wright Field, Dayton, Ohio.

Open mill capacity—in size as well as alloy and shape—must be available, or else order must be rejected.

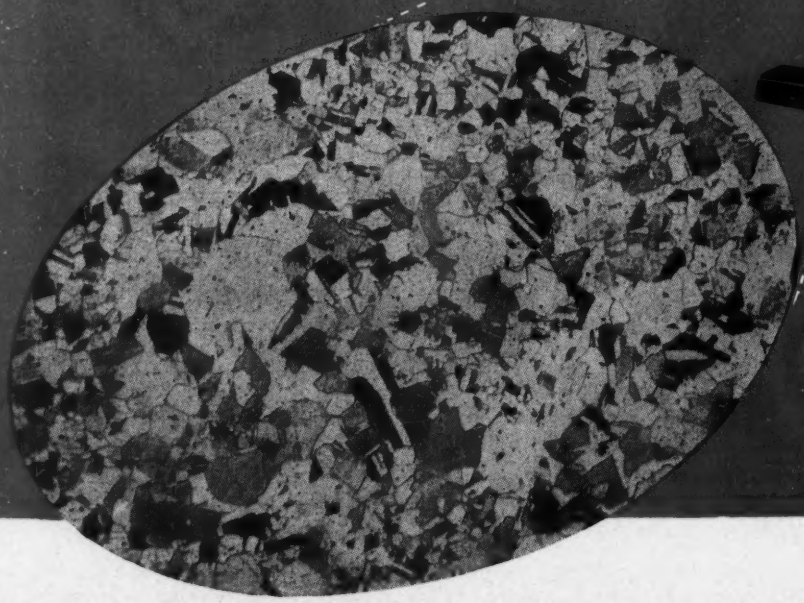
DELAY FACTORS:

1. Waiting for carload lots before shipping from mills.
2. Government inspection time.
3. Specifying exceptionally close tolerances.
4. Refractory alloys—silicon, aluminum, beryllium, phosphor bronze, etc.—take more time to produce than the ordinary alloys.
5. Machine breakdown delays. (Under CMP, mills are allowed to ship in month after promised delivery month if breakdowns occur.)

NOTES:

Pure copper products in forms and sizes shown take about the same time as alloys.
Forgings need extra operations, adding about two weeks to rod and bar operations as shown.
Castings depend on finish required.
Under CMP, mills can reject refractory alloy orders placed less than 60 days prior to specified month of delivery, and other metal orders under 45 days.
Under CMP, mills cannot ship earlier than 15 days prior to month of specified delivery, and they may ship in following month if necessary because of breakdown delays.

BECAUSE OF SUPERIOR QUALITY
Trent-Welded Stainless Tubes
ARE PLAYING A DRAMATIC PART
IN THE WAR TO SPEED VICTORY



Cross section through the weld zone at 100 diameters. The refinement of the weld and parent metal is even more evident at this high magnification.

— *but we are planning for* PEACE!

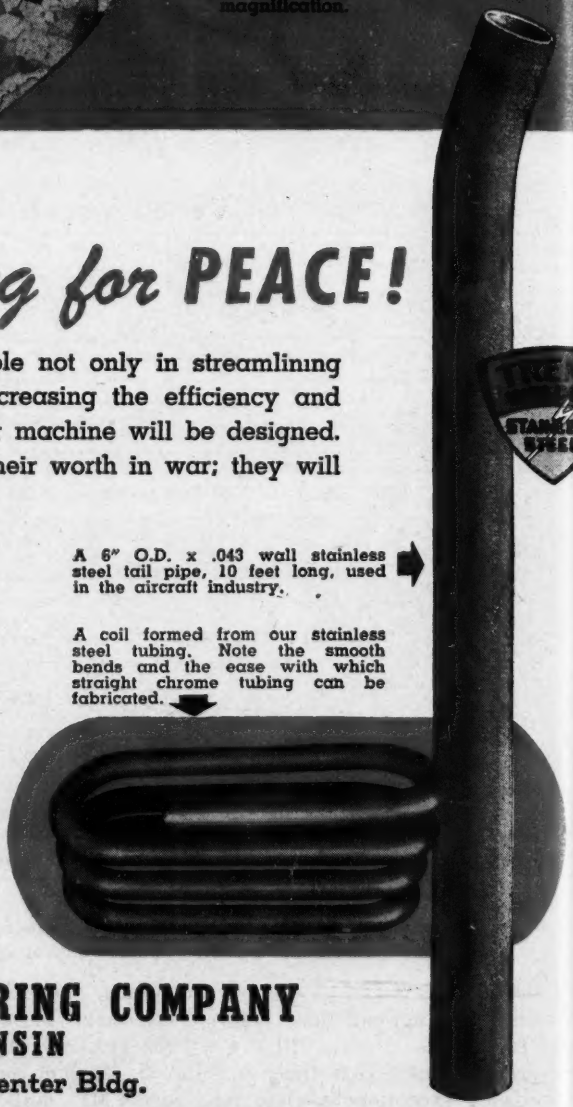
Trent-Welded Stainless Tubes can be invaluable not only in streamlining and modernizing your product, but also in increasing the efficiency and safety in handling the products for which your machine will be designed. TRENT-WELDED Stainless Tubes are proving their worth in war; they will do a far better job in peace.

Due to a new method of automatic weld control, we have successfully made well over a million feet of welded and cold drawn tubing. By this method of welding, the heat-affected zone is held to a minimum resulting in a very homogeneous weld. When cold drawn and annealed, the structure of the weld is almost identical with that of the base metal.

In addition to the conventional range of sizes, our welding methods are especially adapted to the manufacture of large diameter (up to 18" O.D.) and as light as 22 gauge tubing.

A 6" O.D. x .043 wall stainless steel tail pipe, 10 feet long, used in the aircraft industry.

A coil formed from our stainless steel tubing. Note the smooth bends and the ease with which straight chrome tubing can be fabricated.



TRENT TUBE MANUFACTURING COMPANY
EAST TROY, WISCONSIN

Detroit Office: 805-806 New Center Bldg.

Let us supply you with complete information about our product. Our technical staff will gladly assist manufacturers in adjusting their tubing specifications to meet their requirements.

Supercharged Ignition Cures "Rough Engine"

MAINTENANCE

Five million engine-miles without ignition trouble—the record hung up by Northwest Airlines with its DC-3's—is a striking performance. Described here is the patented system which made it possible, the invention of NWA Electrical Engineer Carl E. Swanson.

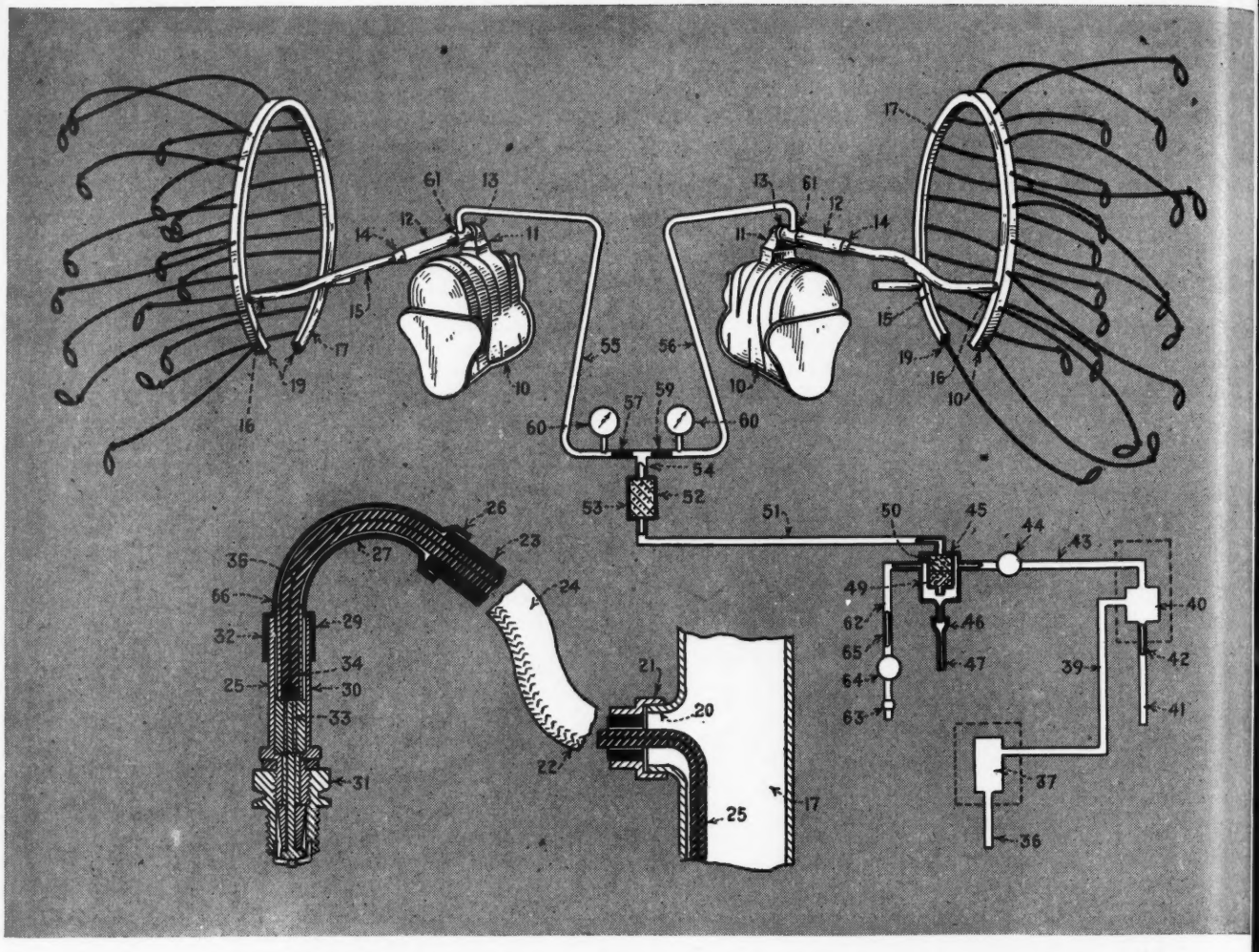
IN SPITE OF ITS SEEMING SIMPLICITY, the ignition harness has long been the cause of more operational trouble and expense than any other single accessory system.

Operating conditions which are extremely severe, are more to blame than anything else, for both materials and workmanship are up to the usual high standard required of all aircraft accessories. Further, the maintenance is performed by the same men who have so brilliantly proved their ability to do a good job well.

Exposed to rapid changes in humidity, temperature, and atmospheric pressure, and of necessity cramped into as small a space as possible, the ignition harness is required to withstand not only an electrical pressure of many thousand volts but also a chemical reaction which is continually augmented by the action of the current passing through the wire.

Since every large airplane uses radio equipment, it is essential that the ignition wiring be shielded, which results in a practically stagnant body of air filling the space between the insulation of the wiring and the shielding outside it. If this space could be hermetically sealed and filled with dry air, most of the usual troubles would disappear. But unfortunately this is not possible. Variations of atmospheric pressure, wind pressure, and temperature all cause unavoidable leaks in the harness, hence

Northwest Airlines DC-3, equipped with supercharged ignition, in flight across state of Washington. Over this route, test described in text was made.



Schematic diagram of supercharged ignition harness for two engines.

moisture, anti-ice fluid, and oil are admitted.

Attempts have been made to prevent the entrance of these substances by filling the inside of the shielding with a waterproof substance (such as grease) which would not only tend to repel moisture but would fill the space to the exclusion of anything else. This has been only partially successful, as will be shown later.

The chief causes of deterioration are: (1) outside substances which enter through leaks, causing electrical spark-over and plug failure; (2) products of electrical and chemical action; and (3) products of combustion which enter through leaks in sparkplugs.

First cause is the effect of leakage and can only be prevented by hermetically sealing the harness—a practical impossibility—or by raising the pressure of the air inside to a point where the leakage will be outward instead of inward.

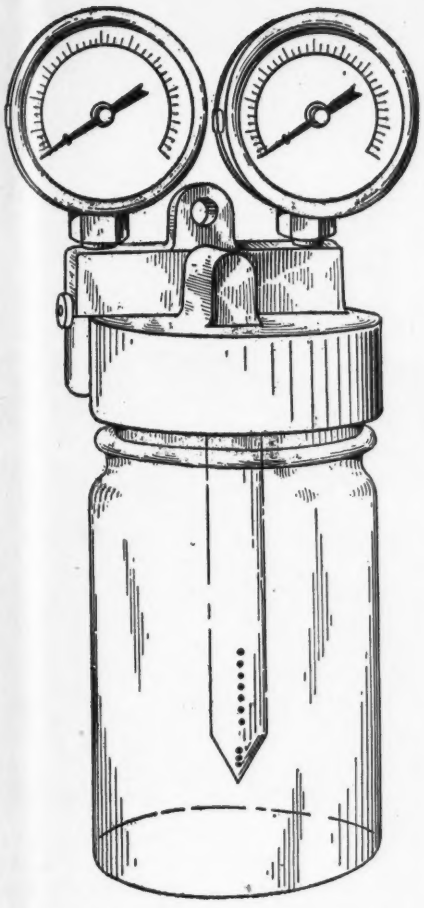
Second cause is more complex. When very high voltage is passed through a conductor surrounded by air, a faint glow appears on the surface, accompanied by a low hissing sound. This is called "corona". Ozone (O_3) is formed at this time, together with nitric oxide (NO) which combines with more oxygen to form nitric dioxide (NO_2). After this, the nitric dioxide is absorbed by the moisture present through leakage, and a mixture of nitric acid (HNO_3) and nitrous acid (HNO_2) is formed. The nitrous acid decomposes, and nitric dioxide is set free which combines with oxygen, as before, until all the NO_2 has formed nitric acid.

Magneto airseal construction. It is not required if magneto is designed for supercharging.

The action of nitric acid on both insulation and metal parts is highly corrosive, causing rapid deterioration, but the most dangerous immediate effect is that the acid turns any moisture film into an excellent conductor, causing spark-over and carbonization, usually developing into a permanent short circuit.

Third, there are the products of combustion which enter through leaks in the sparkplugs. (It is not generally known that this leakage is a recognized and allowed-for defect, but a very small amount of leakage is not unusual and is generally provided against in specifications by stipulating that up to a certain point it shall not be cause for disqualification.)

Within the sparkplug shielding, the damage caused by acids and moisture is greater and more rapid than at any other point. Small springs, used to provide resilient connections, are frequently rusted completely through, and it is within this shield that the larges



Container for drying agent, with aluminum head, pressure gages, and constricted orifices to prevent excessive flow. Air enters through center tube.

number of failures occur. When the sparkplug shield is isolated from the balance of the shielding to exclude moisture, the effect of leakage from the cylinder head is intensified, since the gases —which contain hydrobromic and sulphuric acids with water vapor—are then concentrated in the most vulnerable part of the entire ignition system. Packing the space within the shield with paste, to reduce the capacity, is not recommended because under severe service conditions the paste frequently bakes solidly onto the mica cigarette, preventing its removal without damage.

Another system is to use tightly fitting rubber grommets at various points, but this has the double disadvantage of isolating (and therefore concentrating) the various contaminations and of weakening the insulation where it passes through the grommet. Failures occur with much greater frequency at these points than elsewhere.

The supercharged aircraft ignition distribution system not only supplies pure dry air to the ignition system at a pressure higher than the surrounding atmosphere, but it also provides a means for removing the contaminated air before it has had time to cause damage or misfiring. In addition, the increase in air pressure inside the harness tends to prevent corona and its attendant evils, corona being developed in inverse ratio to the air density, other conditions being unchanged.

Referring to our schematic diagram of the supercharged ignition harness, part 37 is an engine-driven, oil-lubricated pump which supplies air through oil separators (40 and 45). The air passes through dehydrating unit (52) into the shielded distribution system at 61. Small orifices (57 and 59) are built into lines 55 and 56 to limit the air loss in case of excessive leakage in either harness, and to enable gages (60) to function as flowmeters as well as pressure indicators. The gages, orifices, and container for drying material are built into a single unit. Oil separator 45 contains an air cleaner filled with cotton (50) and copper wool (49) with a relief valve (46) which keeps the pressure above that of the atmosphere.

If compressed air free from oil vapor is available, the oil separators may be omitted. In the right landing wheel well is a connection for attachment to an outside air supply while on the ground. This connection has a constriction (65) and a ball check valve (64) limiting the air flow to slightly more than normal requirements, the excess passing out through relief valve 46, thus keeping the pressure equal to that used during flight.

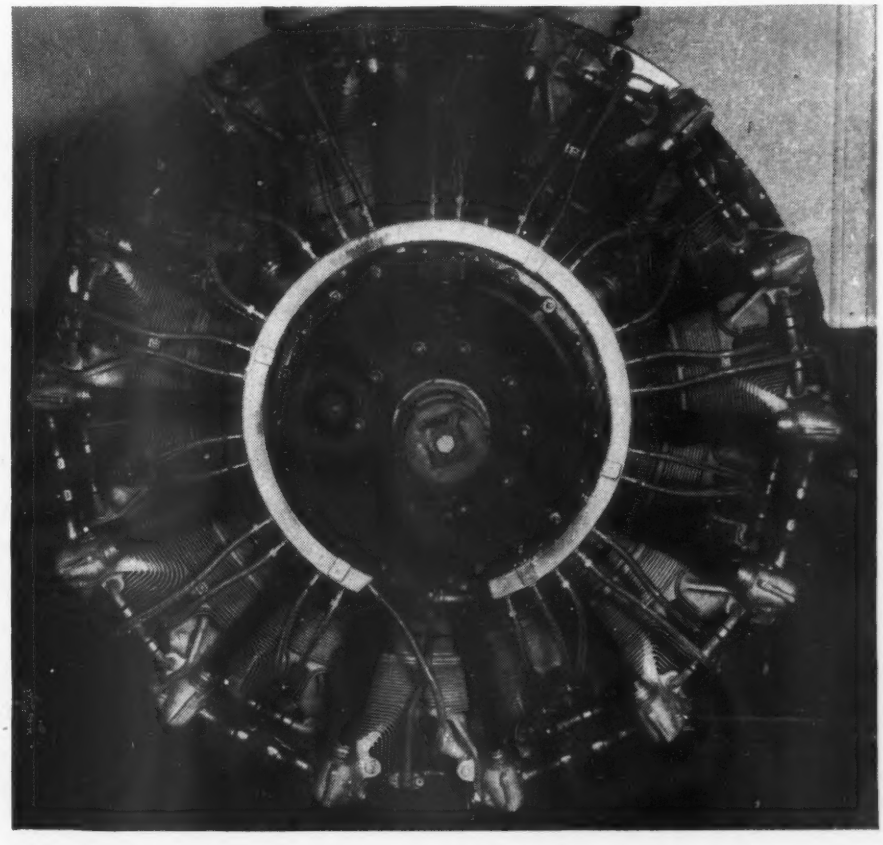
The pressure inside the harness prevents outside moisture or fluids from leaking into the shielding, and the connection to an outside air source permits the harness to be kept free from moisture even when standing for long periods under adverse conditions. To obtain the greatest benefit from this system at high altitudes, the magneto and distributor should also be connected to the supercharging system, though this is not feasible unless the magneto has been designed for this purpose.

For providing extremely dry air, the dehydrating unit (52) contains activated alumina or silica gel, substances which absorb up to about 25 percent of water before saturation.

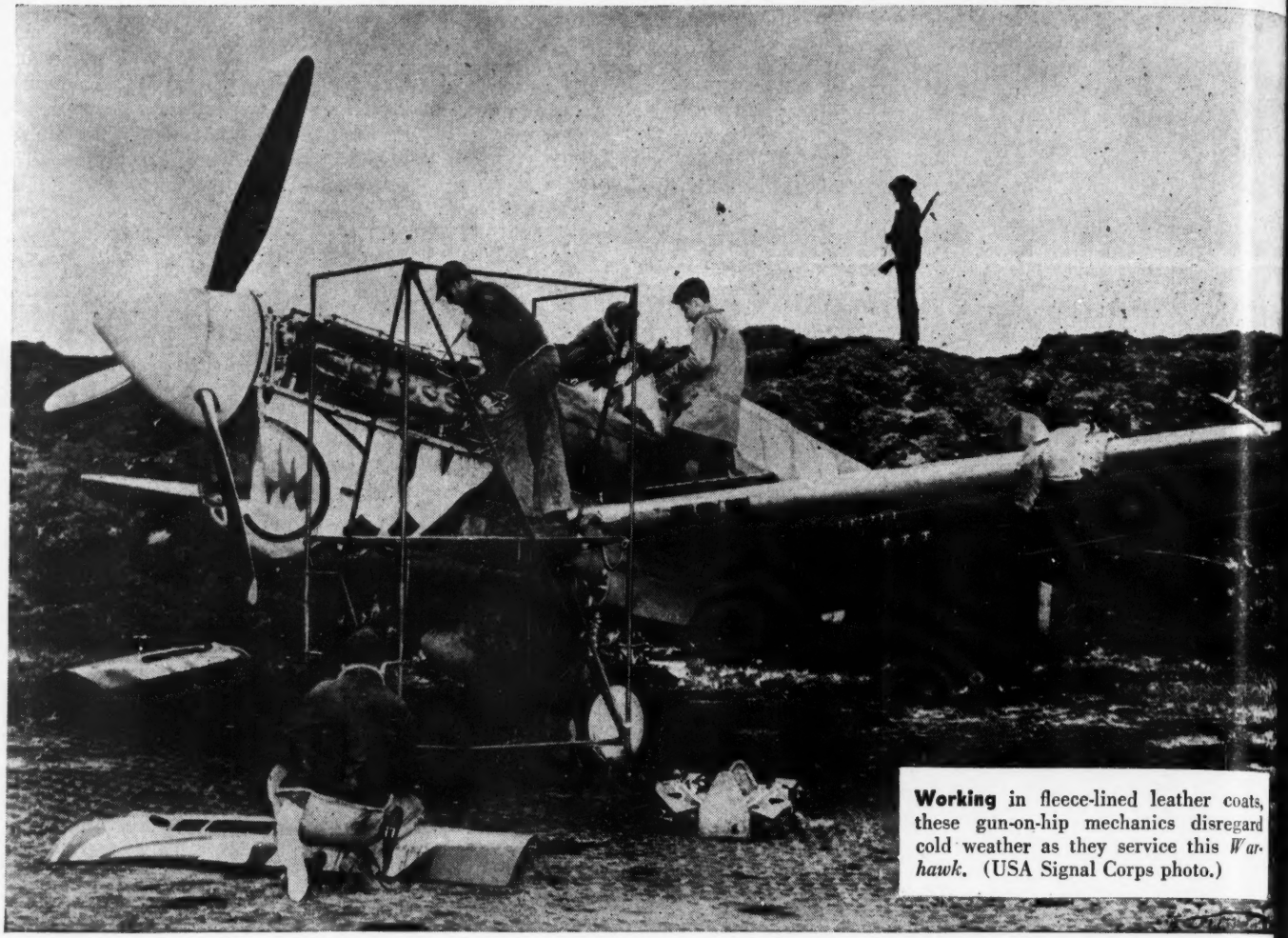
Flow of this dry air through the harness has the effect of cooling the insulation so that its life is prolonged considerably. In fact, instead of replacing the entire wiring at each engine overhaul period, wiring has been returned to service in excellent condition after the normal 600-hr. period.

This system has been subjected to tests more severe than would be possible under working conditions. In the laboratory the entire ignition manifold with the individual leads to the spark plugs, together with the plugs themselves, were immersed in water. The open ends of the plugs were fitted into carbon dioxide "bombs" for protection.

(*Turn to page* 359)



Supercharged ignition harness on Northwest Airlines DC-3 Pratt & Whitney engine. (Titeflex Metal Hose Co. photo).



Working in fleece-lined leather coats, these gun-on-hip mechanics disregard cold weather as they service this *Warhawk*. (USA Signal Corps photo.)

"Master of Knack" Is the Service Rep's Degree

He gets no medals. But despite cold, ice, heat, rain, mud, darkness—and punctuation by enemy bullets—he finds ways to keep the warplanes fighting, even if he has to concoct "barrel" equipment, "coin" washers, "vase" fuel tanks, and animal-hide patches. What's more, if planes are lost, he finds 'em.

HARD, DIRTY, FREQUENTLY DANGEROUS, the work of servicing warplanes on the fighting fronts is far from glamorous. The one measure of a combat craft's value is its ability to fly and fight, and the one job of the serviceman is to see that it does. To that end, Curtiss-Wright sends its field representatives to all fronts where Curtiss planes are fighting.

Interesting stories concerning their experiences are told by Curtiss men returning to the plant from the far corners of the world. For instance, men back recently from Alaska and the Aleutians tell of the revetments they erect to protect personnel and airplanes from the cutting winds.

"A revetment is similar to an oversized foxhole," service men relate. "It's built for protection against the elements and against the enemy who's liable to ride in suddenly on the tail of a snow squall or a dust storm. These revetments are scooped out of the ground to a depth of several feet and expanded over a considerable area. A breastwork of earth is piled about the midget amphitheater, and in this protected section mechanics and aircraft technicians work on the airplanes. Even under this protection the dampness and severe cold numb the fingers and hands to such a degree that working on an airplane is a tough and sometimes painful job.

"Imagine the job of tightening the bolts on a cylinder head wearing thick mittens. Or trying to crawl into a small corner of the cockpit bundled down with heavy sheepskin-lined pants and jacket. Starting engines in that sub-zero temperature is a headache in itself. Suppose the airplane is due for an engine test at eight o'clock in the morning. To get the engine turning over by 8 o'clock you have to get up at 3, and if you're lucky and the temperature only dropped to 20 or 30 deg. below zero that night you might run your engine test on schedule.

"Crackups in the North are not infrequent. Because of poor visibility due to the fog and snow squalls and restricted landing areas, pilots have a

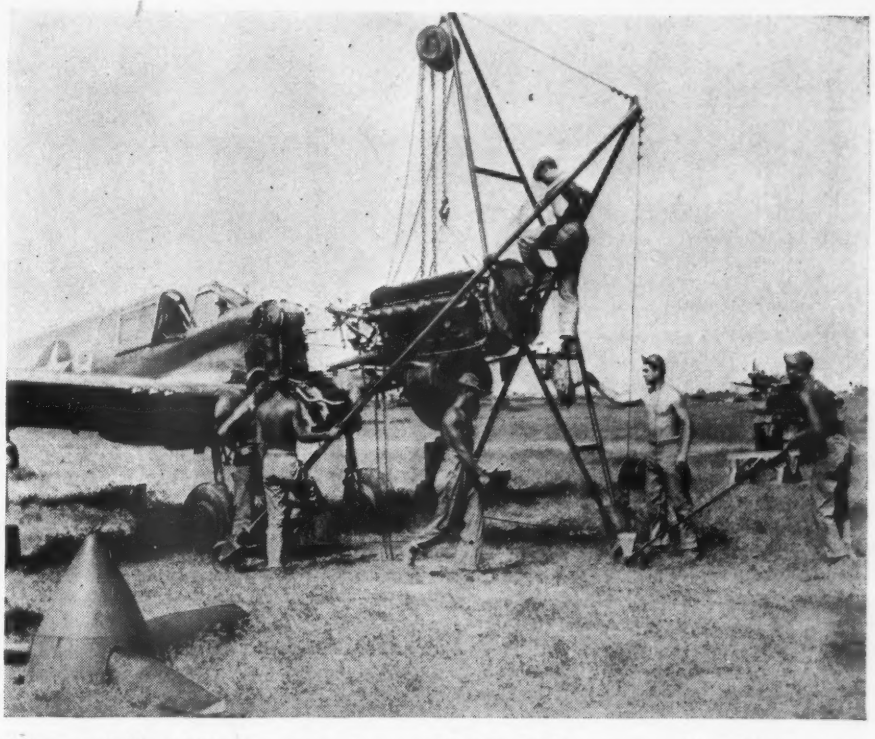
habit of overshooting or undershooting the runways. The runways are usually made of steel matting, and if the pilot doesn't hit it he's in for trouble and so are you.

"The ship must be repaired immediately, and it's your job to get out there to the scene of the crash, maneuver the airplane to whatever shelter you can, and dig in.

"We've practically rebuilt planes up there, working steadily through snow storms, sleet, rain and fog, with our clothes frozen, our feet and hands numb; and cursing the day we ever came to a country that spawned such violent weather. But we got the ships flying, one way or another. A major portion of the work is done at night under artificial light, such as flood lamps or flashlights. On top of this, most of planes were landed at some remote port and ferried by motor truck across hundreds of miles of desert and jungle before assembly. During this trip the guns would collect sand and dirt, which is not inducive to smooth action after they are assembled. When the planes reached their base they were needed so badly that the original grease was not removed nor were the guns cleaned. They went right up to fight. Hence jammed guns were not uncommon."

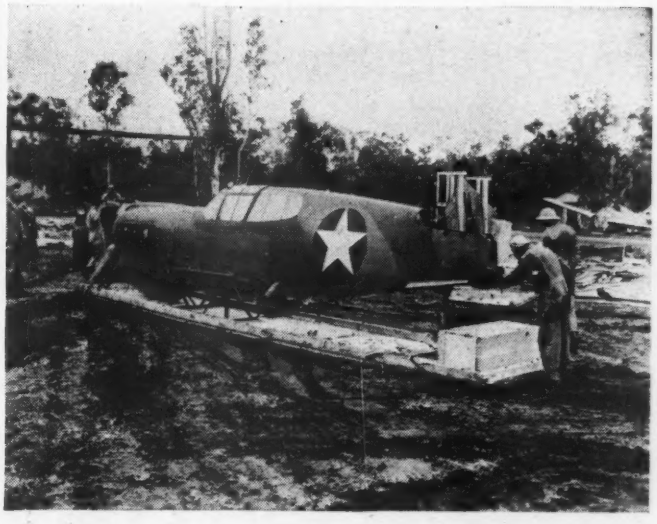
Africa is a vast country and the airplanes were scattered. Nevertheless, the first service men on the scene tackled the machine gun job and licked it. They shuttled up and down Africa stripping the weapons off ships and conducting classes in machine gun repair. Many times they worked during air raids to get a machine gun back in its wing sheath while some young hellion of a pilot with his eyes on the sky action alternately prayed, cursed, and pleaded with them to get those guns working so he could get up there and knock down a Jerry or two.

Pushing with Montgomery's Army from El Alamein to the Mareth Line, ground crews used anything handy for repair work. Here, oil drums and a packing case are pressed into service. (Irwin, Curtiss-Wright photo.)

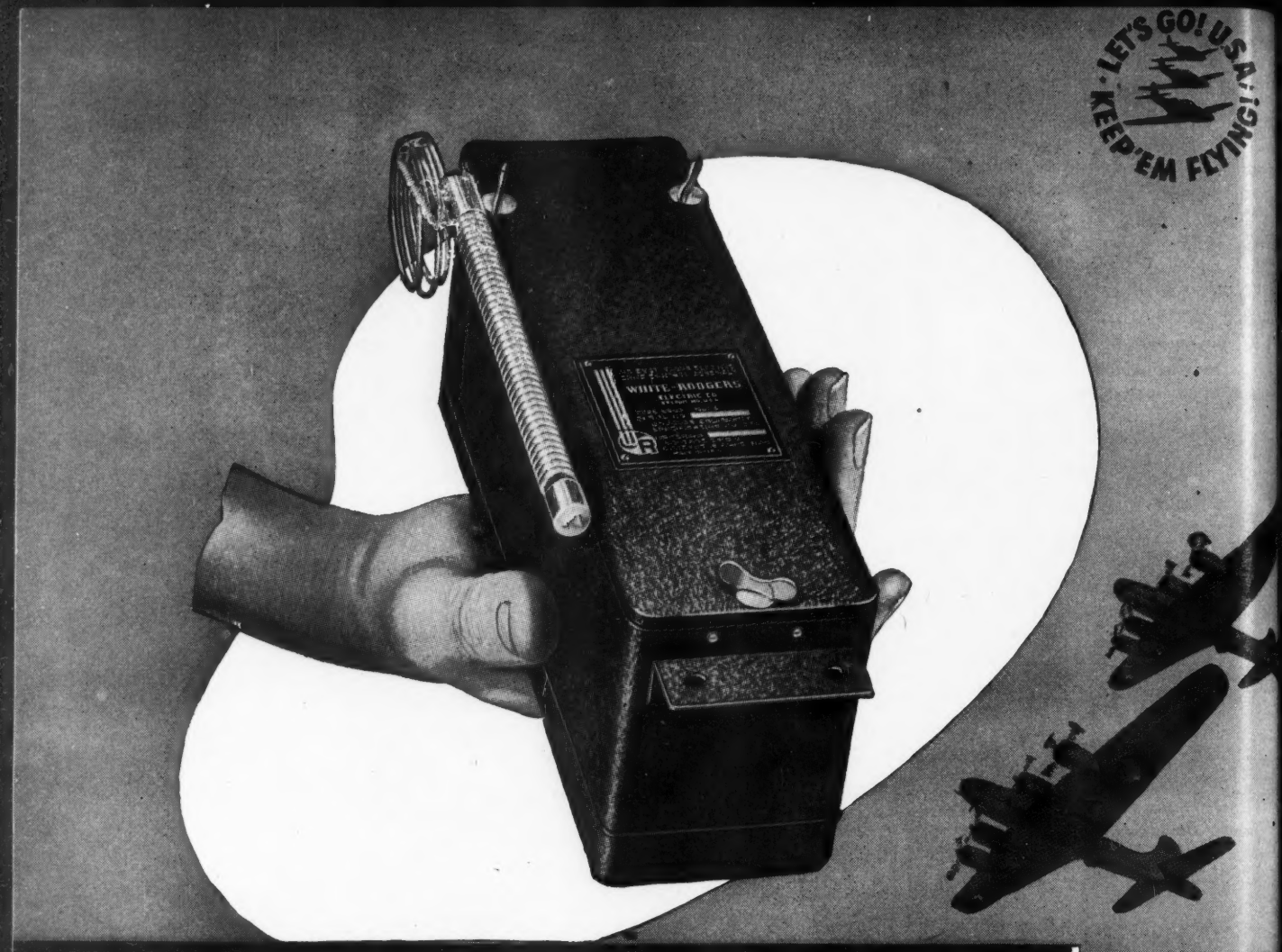


Using portable hoist, heavy-tanned men with 57th Fighter Group, 9th USAAF, change engines on P-40 in Africa. (USAAF photo.)

Sometimes P-40's were assembled on packing-case flooring to keep them out of sand while hangar (behind) was still being built.



At other times, packing-case pieces served as rafts to keep planes out of mud, such as here in New Guinea. (USAAF photo.)



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Such assemblies can be adapted specifically to your design requirements for any application involving automatic temperature regulation, by local or remote control.

Engineering data will be furnished to manufacturers on request.

Plane Photos Courtesy U. S. Army

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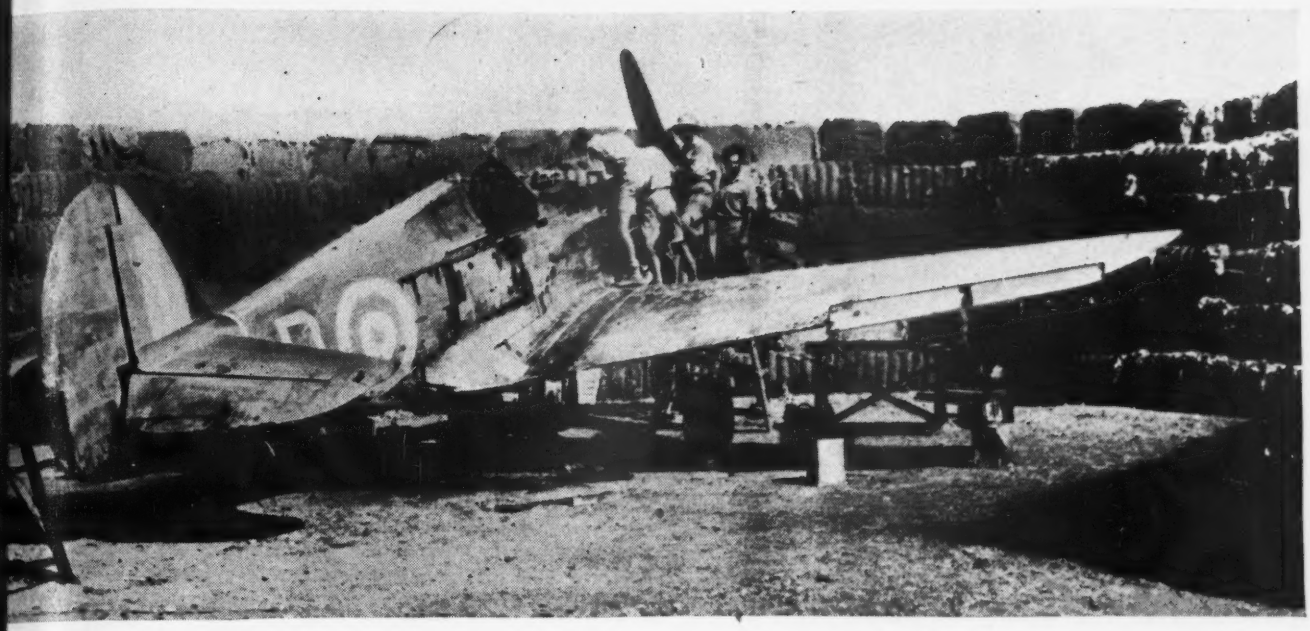


On beach cotton bales were used as shelter. Water stood less than a foot beneath surface. Revetment was necessary to stop strafers' bullets. (Carpenter, Curtiss-Wright photo.)

Service men in the Far East and the Western Desert of Africa tell of repairing and servicing warplanes under a blazing sun, wind, sand and air raids. In the earlier days of the African campaign and to a lesser extent right on through to the attack on Pantelleria and the invasion of Sicily, American warplanes were having trouble with faulty machine guns. An airplane with faulty guns is a very sad affair, indeed. It can fly well enough, but if it can't fight back it might better stay on the ground.

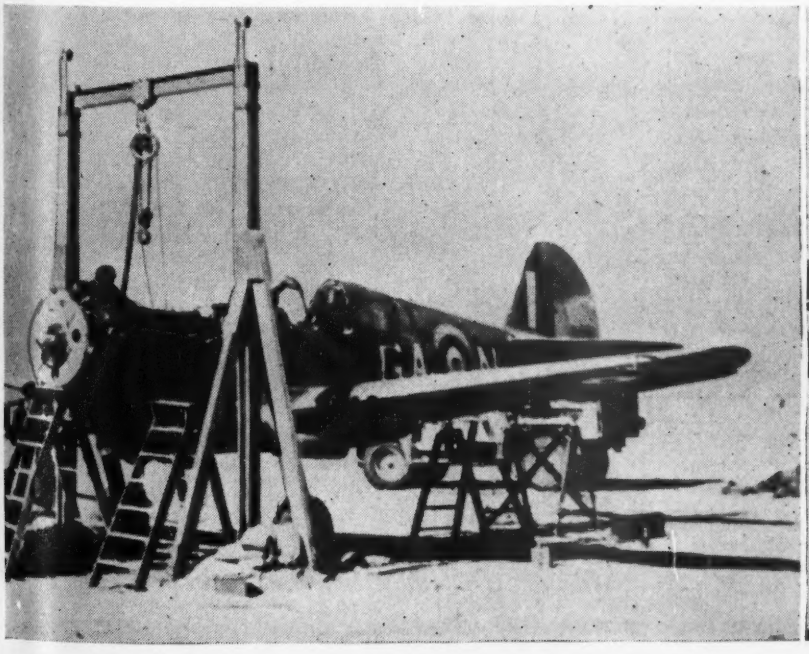
Men found in the first days of the war that effects of the long transportation from this country to Africa constituted one of the reasons for machine guns jamming. All parts of an airplane are covered with a protective grease before leaving the factory to protect them against the elements during the long boat trips, but even so, salt water manages to penetrate this grease film.

Sand was a distinct hazard in the Western Desert. In the desert it makes up the very air you breath. It gets in your eyes and ears and nose. You eat and drink it. What it does to the delicate mechanism of an airplane is a nightmare. All Curtiss warplanes are equipped with filters to eliminate as much as possible foreign elements in the air. But despite these precautions sand will sift through the finest filter and raise Cain with the insides of an airplane. Service men tell of tedious hours spent in ripping down airplane engines, living out in the desert, growing beards, getting lousy—but keeping those ships in the air.

One man tells of running into landing gear trouble on the Western Desert. The P-40's were having difficulty. They'd

(*Turn to page* 305)

British 8th Army gallows hoist used by Curtiss repairmen for landing gear and other heavy repair work. *Kittyhawk* is resting comfortably after her operation. (Irwin, Curtiss-Wright photo.)



This peaceful (at this point) scene signifies that one more job has been well done and another *Warhawk* is on a shooting trip. (USAAF Signal Corps photo.)

SEVERANCE DISC CUTTERS SPEED FINISHING OF PLASTICS

When it comes to finishing moulded plastic parts, you can't beat Severance Cutters. One efficient installation is shown here. A Severance rotary disc cutter mounted on a spindle with an adjustable table allows perfect finishing of the rough edges with amazing speed.

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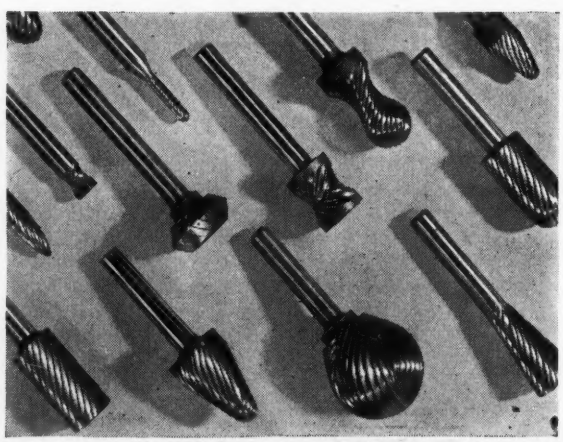

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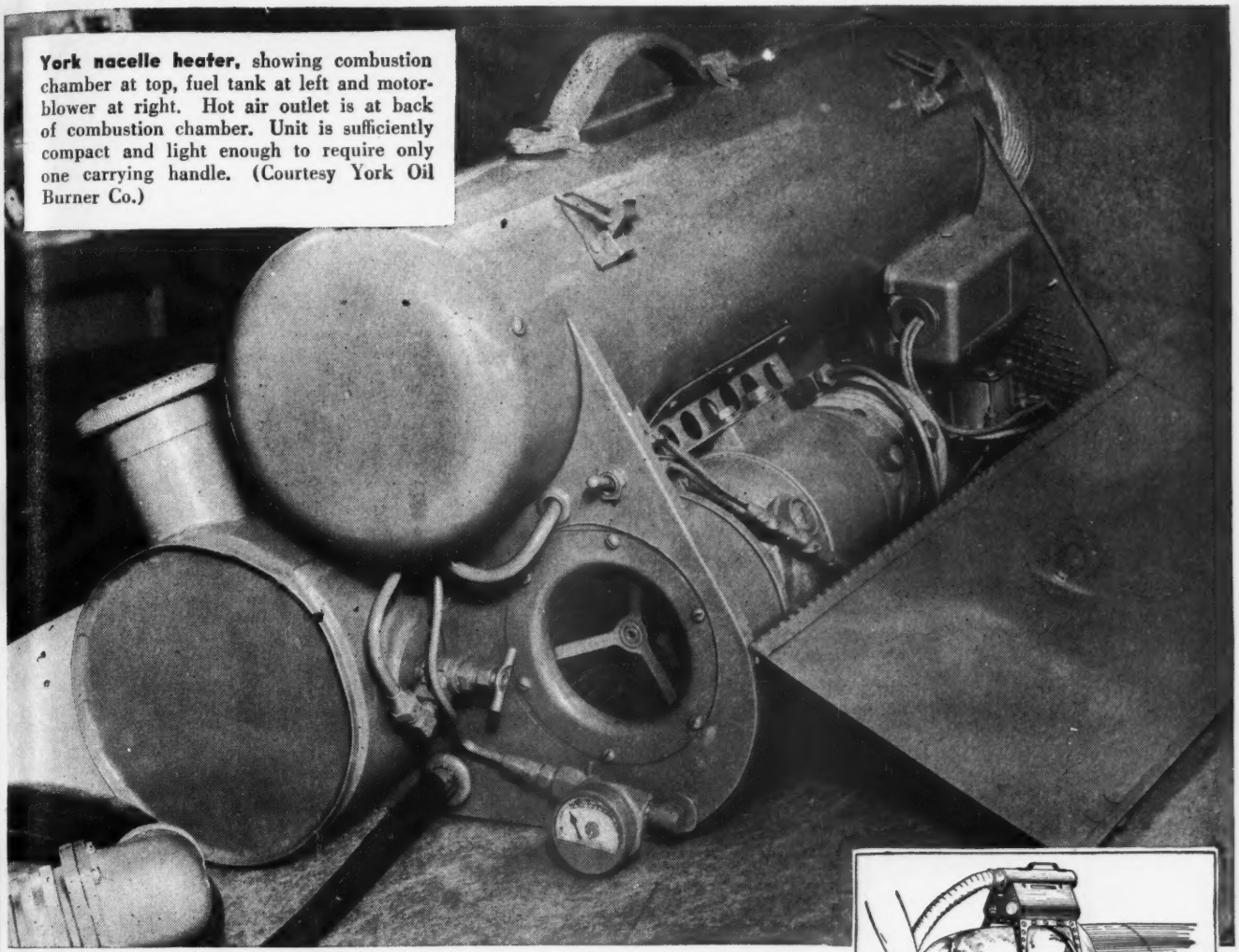
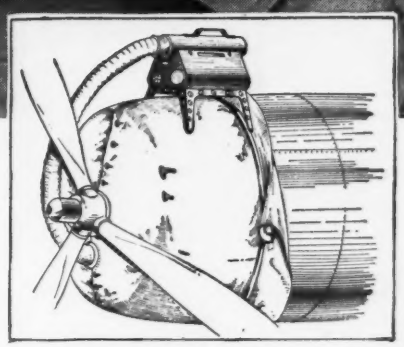


York nacelle heater, showing combustion chamber at top, fuel tank at left and motor-blower at right. Hot air outlet is at back of combustion chamber. Unit is sufficiently compact and light enough to require only one carrying handle. (Courtesy York Oil Burner Co.)

Fast-Action Portable Engine Heater



Using special cradle, heater can be operated from mount atop cowling.

Problems of weight, space, and output have been successfully overcome in this heater design, which gives over 2,000 B.t.u. per hour for every pound of its weight.

COLD HAS ALWAYS BEEN the enemy of maintenance men. Though many devices are in use for heating or keeping warm engines and other parts of the airplane, the apparatus has been either too heavy or cumbersome to be taken on long flights as part of the standard equipment.

A heater was required which would be light enough to be carried on the plane; which would have an output large enough to heat the engine under any circumstances; and which would use engine fuel to avoid the necessity of a separate supply. A duct was needed to deliver heated air—one large enough to handle considerable volume but light, flexible, and capable of withstanding rough usage.

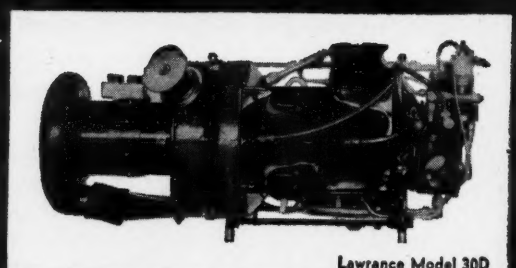
To fill this need a heater has been developed by the York Oil Burner Co. having a capacity of nearly 99,000 B.t.u. per hr. and with a total weight of about 40 lb. At 30 deg. below zero the output is 360 cu. ft. per min. at 192 deg., while at 15 deg. above zero 341 cu. ft. per min. are delivered at 225 deg. Tests have shown that heater will bring a 2,000 hp. engine from 30 deg. below zero to starting temperature in 20 min. using the standard engine cover. Patrol bomber engines have had their temperature raised 227 deg. in 45 min. without injuriously overheating those parts nearest to the source of heat.

The heater consists of an electrically operated blower which, through a carbureting device, delivers air to a burner where it is ignited by a sparkplug. Fuel sufficient for 5 hr. operation at 90,000 B.t.u. per hr. output is carried in a tank beside the blower motor. The burner chamber is above. The entire assembly forms a compact unit which can be carried with one hand.

The compressor, of the rotary vane type, is direct driven by the motor, which operates on battery current and is provided with a 9 ft. connector cord. The 6 in. dia. flexible duct enables the oil radiator to be heated prior to starting the engine, thus largely obviating the necessity for oil dilution.

High and low temperature regulation is controlled by a bimetallic element in the airstream. An automatic shut-off valve controls the fuel flow in the event of stoppage.

TURRETS TURN TO DEPENDABLE *Lawrance* POWER



Lawrance Model 30D

AUXILIARY POWER PLANTS

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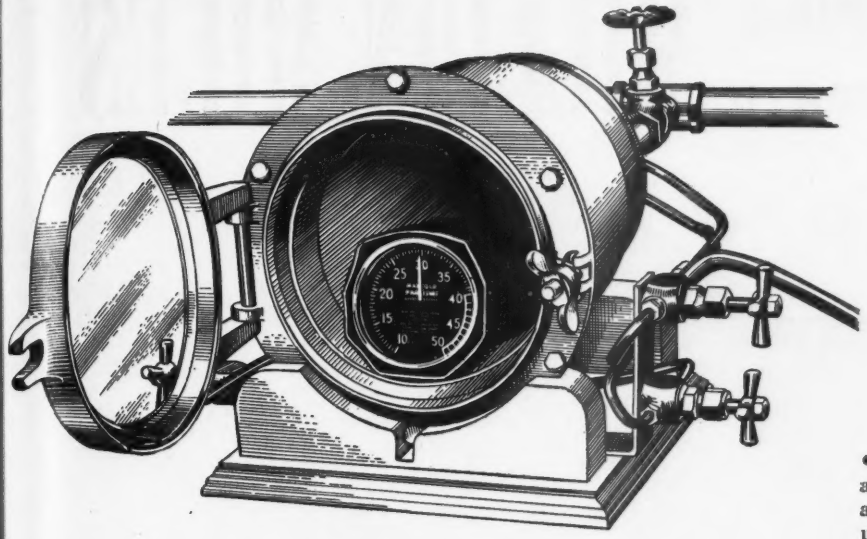
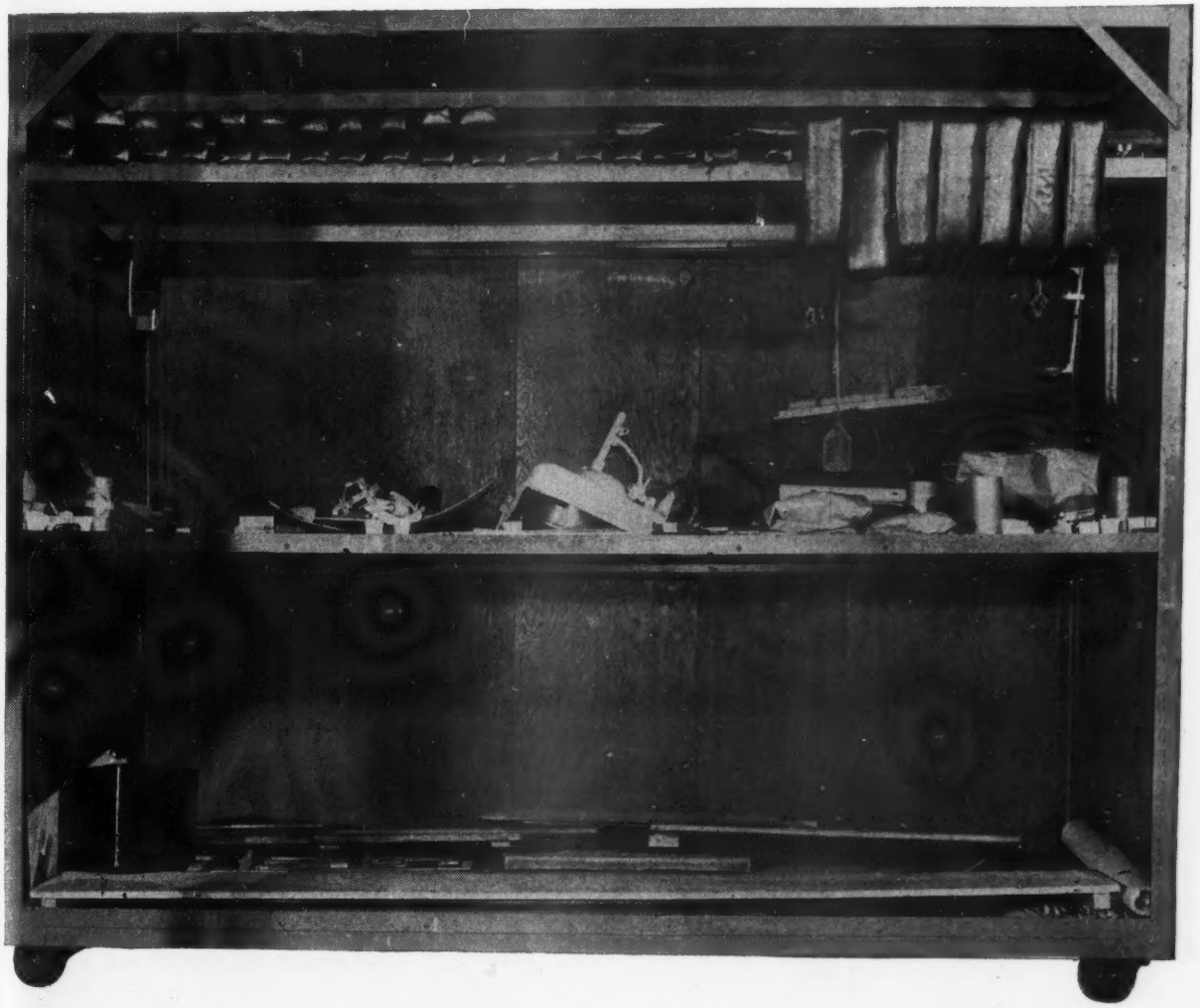


AVIATION'S MAINTENANCE NOTEBOOK

Pressure Chamber From Old Cylinder

• Instrument shop at Pan American's Miami base built this pressure chamber from an old cylinder and a boat porthole. It is used to test manifold pressure gages and other instruments for leakage.



Parts Rack at American Airlines

• Used when dismantling for overhaul, this rack is pushed up to side of ship to receive all parts removed. It keeps them classified and saves steps and handling.

Cessna Test Pilot, who has flown a MILLION MILES

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"I have flown a distance equal to 40 times around the world As a CESSNA Test Pilot I can say that the positive displacement, non-pulsating ROMEC fuel pumps, and the ROMEC vacuum instrument pumps are darned good pumps. In fact, they improve the dependability of the CESSNA—the finest trainer made"

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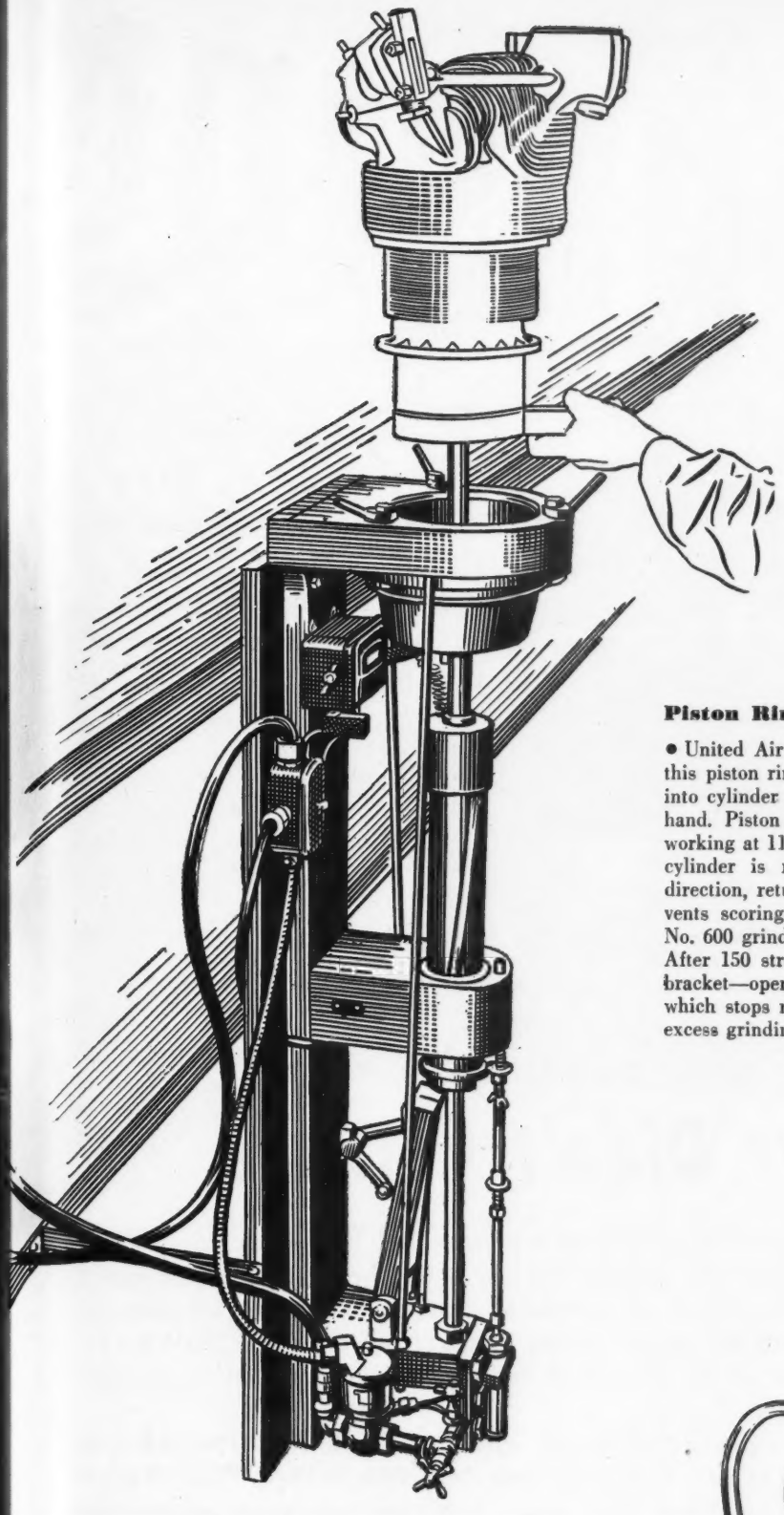
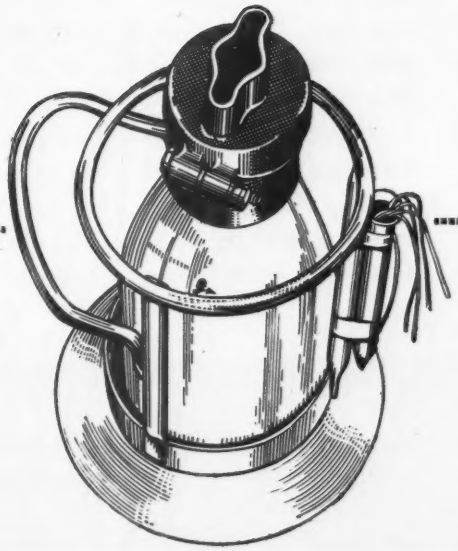


Piston Ring Lapping Machine

• United Air Lines' Cheyenne base designed and built this piston ring lapping machine. Rings are compressed into cylinder by a band $\frac{3}{32}$ x 1 in., shown in operator's hand. Piston is given vertical motion by air cylinder working at 110 psi. By using a spiral and ratchet device, cylinder is rotated 40 deg. on each stroke in one direction, returning in a straight line. This action prevents scoring of rings. Rate is 60 strokes per minute. No. 600 grinding compound is used to give final polish. After 150 strokes, Veeder counter—shown beneath top bracket—operates Minneapolis-Honeywell magnetic valve which stops machine. Pan beneath top bracket catches excess grinding compound.

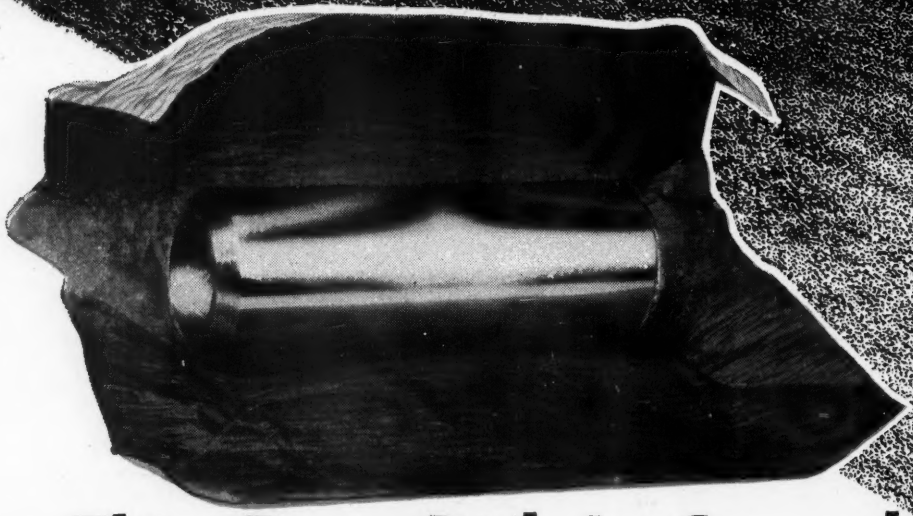


Fuel Tank Sump Drain

• For draining fuel tank sumps without spilling liquid over both plane and operator, this bottle holder was made by PAA's Brownsville shops.

CORROSION

THE TOUCH OF DEATH TO STEEL



But This Part Didn't Corrode

For over a year this oil-slushed part has traveled in a packaging engineer's briefcase throughout the United States. It has been unwrapped many times, and touched by hundreds of corrosion-starting fingers in all sorts of weather — then wrapped up again in its original ANGIER INDUWRAP* Inhibitive Dual Wrapper. Not a trace of corrosion developed on its mirror-like surface.

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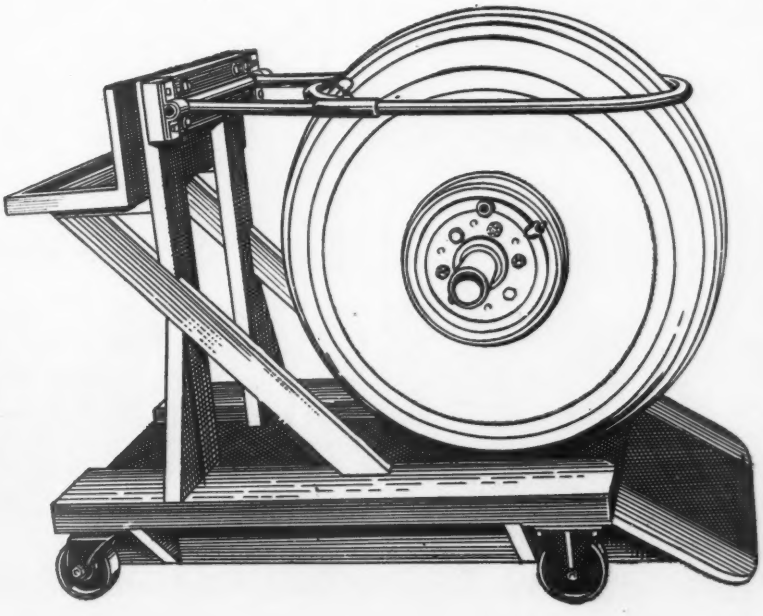
Twin Strut Assembly Jig

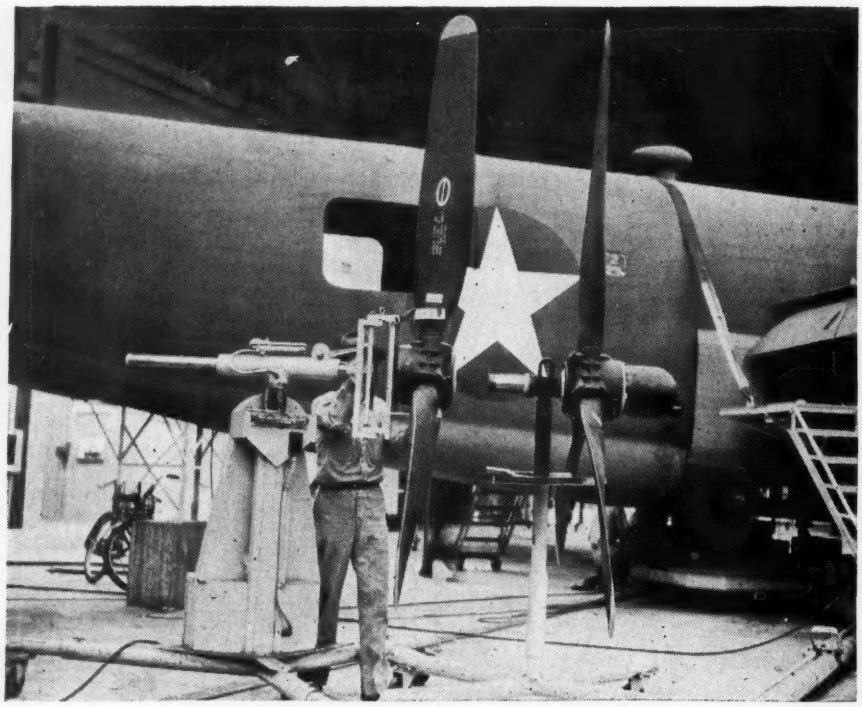
• Here is folding twin-strut assembly stand used by Pan American's hydraulic shop at Miami. When not in use, it folds against pillar. By using this platform, work of assembling and testing twin struts has been simplified, and a great deal of time is saved.

Servicing Dolly for All Tires

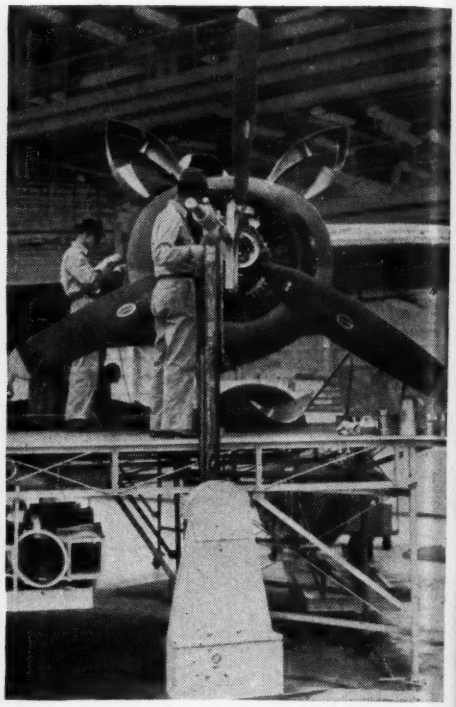
• This dolly for handling all sizes of airplane tires was developed by Asst. Foreman Scott Wadkins of PAA's Miami shops. Retaining bar at top is adjustable with fingers. At rear is rack with space for tools.



One-Man Dolly Slashes Propeller-Mounting Time



Propellers are transferred from storage dollies to installing apparatus, which is easily adjustable to proper height. All points of contact with propeller are padded, and a strap holds upper blade in yoke. A towing tongue makes moving of unit a simple matter.



Right: Dolly is placed in approximate position in front of engine. Adjustments in apparatus make further moving of dolly unnecessary. Electric power raises propeller, manual crank on cantilever arm extends it in over work stand to engine.

Convairman's device releases 3 men and saves 3 hr. in installation of airscrews on C-87, freeing monorail crane for other jobs.

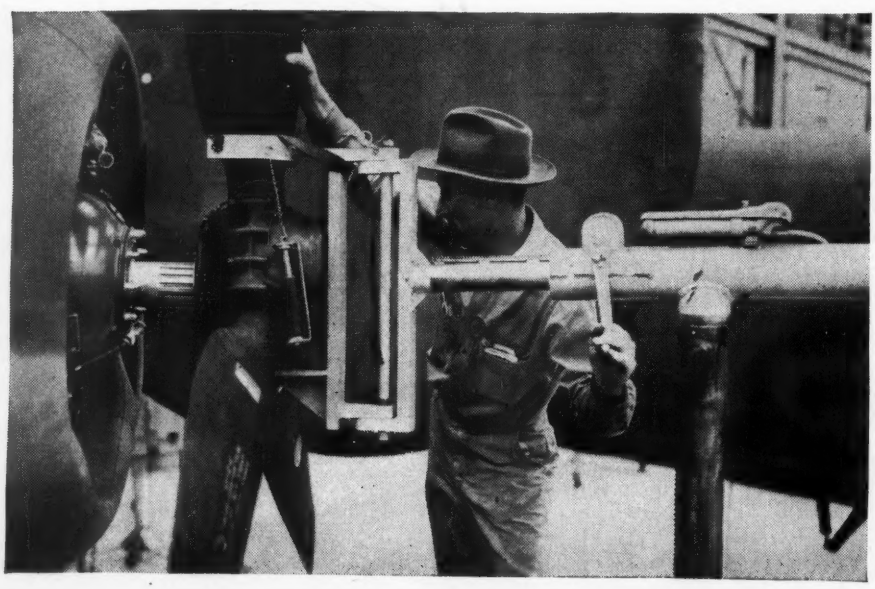
A LIFTING DEVICE to save the work of three men plus 45 min. of time in mounting each of the three-bladed propellers on Consolidated Vultee's four-engine C-87 *Liberator Express* transports has been put into operation at Convair's Fort Worth plant.

Expected to save more than $100,000 annually, the device was designed and built in the plant by Howard Kittel, assistant plant engineer. With its use, one man can now do in about 5 min. a job that formerly took four men 50 min. The old method involved lifting the 400-lb. propellers into place with an overhead crane.

Aside from saving 3 hr. of production time on each plane, the device permits the shifting of two men to other departments, also releases a monorail crane and its operator for other jobs.

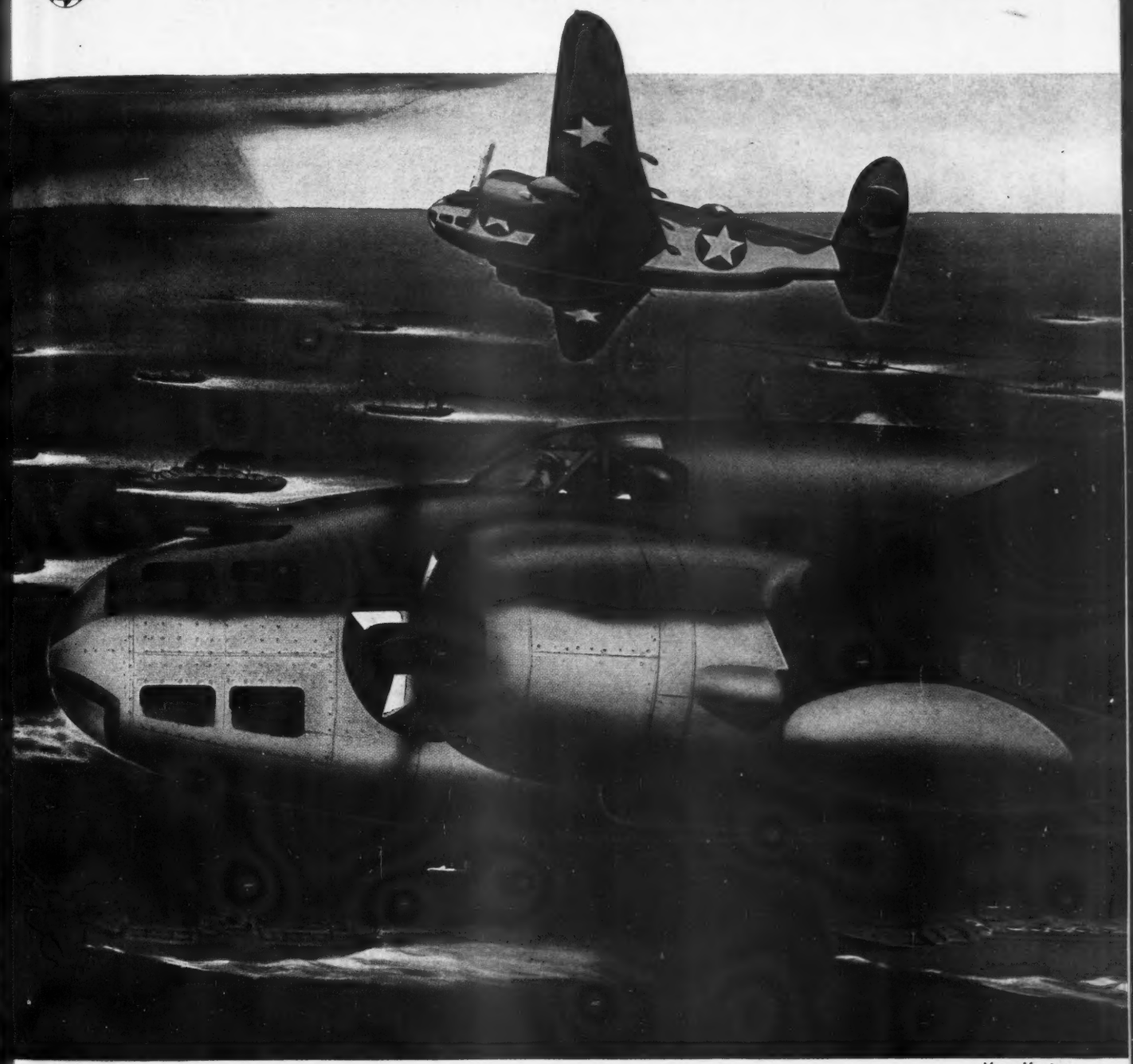
Propeller mounting is complicated by the need of an underwing platform extending 20 in. forward from the engine to provide working space. An ordinary lifting device is impracticable, since it cannot move closer to the plane than the edge of the platform. One means was to lift by hook and cable from the monorail crane overhead, but this operation was complicated by the fact that

(*Turn to page* 325)



Final height adjustment is accomplished by supplementary hydraulic ram seen on top of assembly. Arm swings a few degrees vertically, as well as laterally, and hub is easily aligned with shaft and thrust home without any additional help.

PERFORMANCE CONTROLS THE AIR



Vega Ventura

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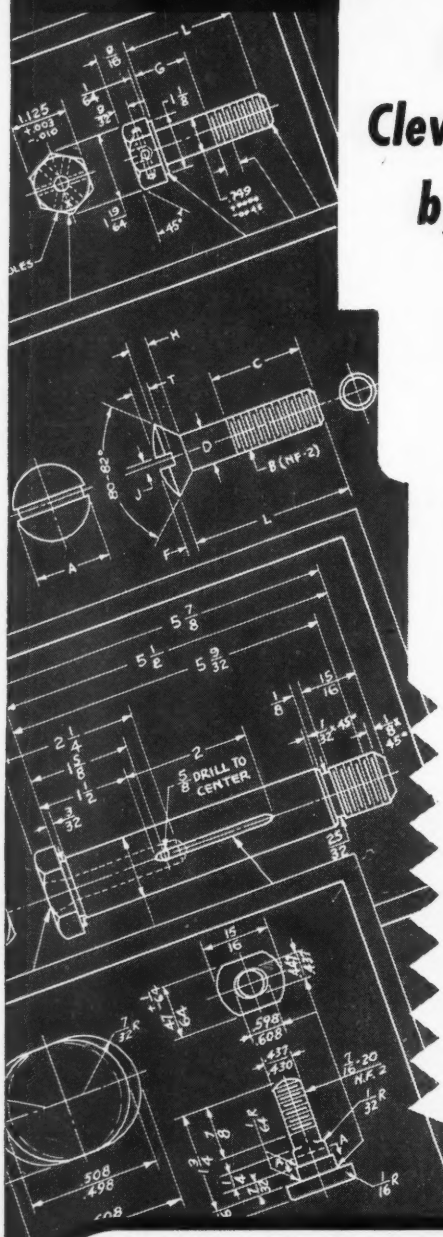

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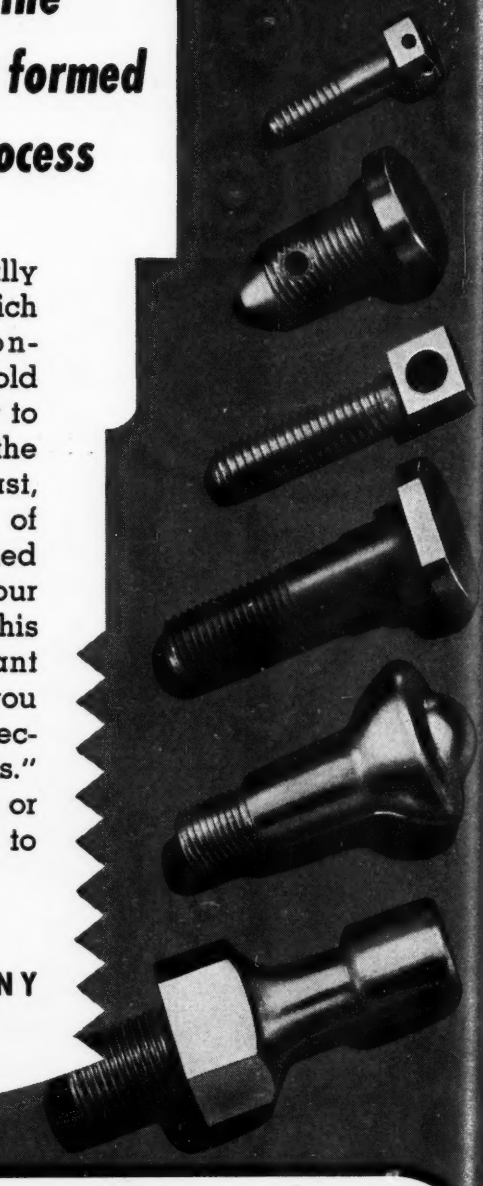

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CRUISE CONTROL For Flying Efficiency

Part VI . . . Current Problems

By **R. DIXON SPEAS**, *Asst. to Vice-Pres. Engineering*
JERE T. FARAH, *Chief Flight Analyst*
SANFORD HINTON, *Flight Analyst*
American Airlines

Cogently considered in this installment are the problems which must be overcome in applying efficient flight control to practical operations.

DETAILS OF CRUISE CONTROL and the methods by which conditions can be maintained as desired have been treated in foregoing articles of this series. We will now discuss some of the current problems.

The outstanding needs with regard to future development may be considered under these general headings:

A. Simplification of Procedures

B. Improvement in Accuracy of Fuel Consumption Indicators

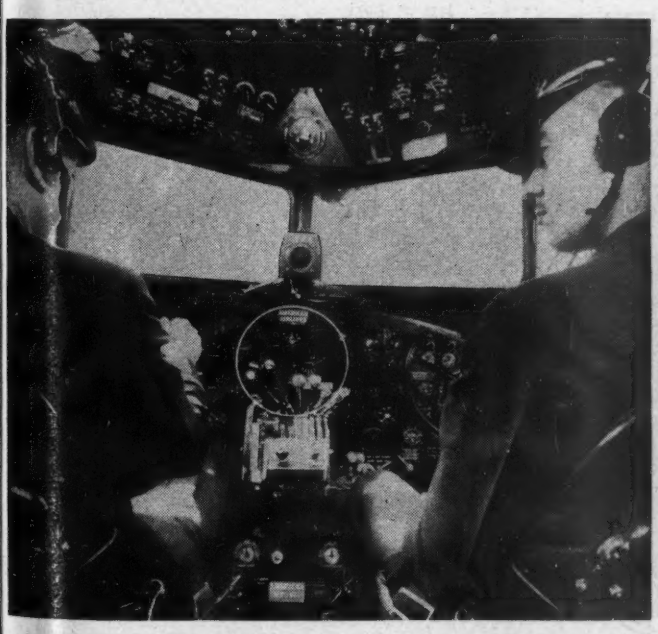
C. Improvement in Specific Fuel Consumption Qualities of Aircraft Engines

D. Improvement in Flight Dispatch Procedures

First of these items might well be considered the most important for all air transport operations where a flight engineer is not engaged. If a review is made of cruise control systems which are designed for maximum efficiency of operation, it will be found that the majority require an engineering background for adequate interpretation. The average pilot cannot be expected to follow conscientiously a procedure which requires a seemingly enormous amount of "chart work", when he knows by experience that if he "just flies" he will get there all right—at least he always has. And regardless of how conscientious and instructive is the airline ground engineer, the pilot will probably continue to "just fly."

Such a condition, of course, created the position of "flight engineer" on long-range transocean operations. Current airplanes are such that the engineer can actually do some maintenance and repair work, as required in flight.

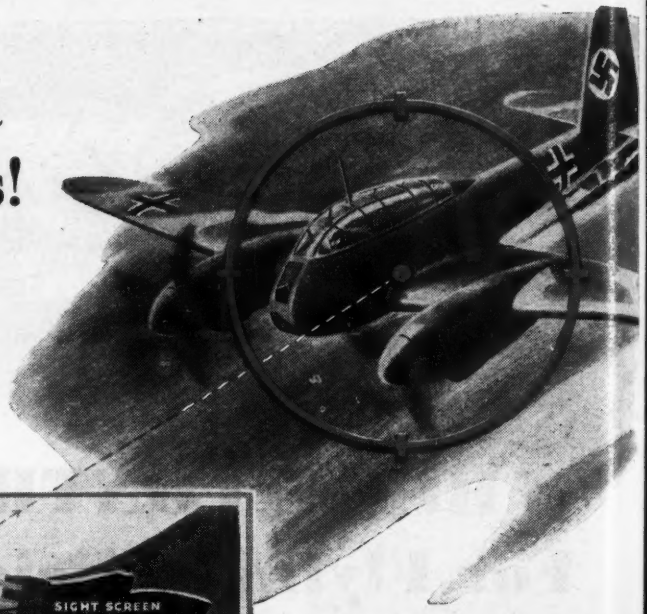
(*Turn to page* 318)



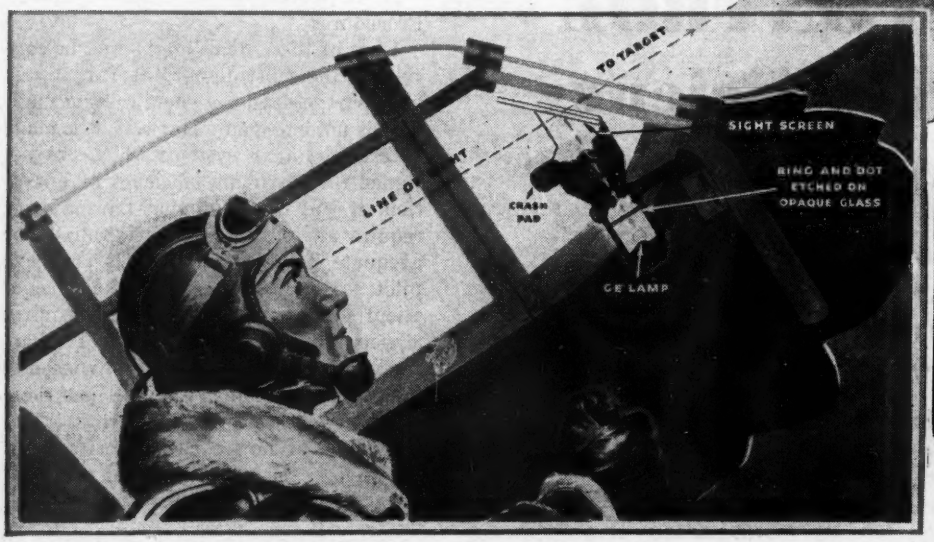
Engine and carburetor controls (circled) are centrally located in DC-3 cockpit for quick operation by either pilot or co-pilot.

Before starting on a new flight, distances must be carefully computed in order to estimate fuel requirements.

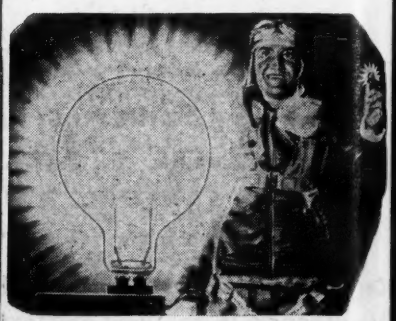
The lamp that paints a bullseye on Axis planes!



1. Ever wonder how our gunners can fire accurately at 400 m.p.h.? One reason is a new kind of gunsight. Instead of straining to hold the enemy in your sights as you would with a rifle, you see a "bullseye" of orange light . . . apparently painted right on the enemy plane! Diagram below shows how it works.



2. Combat experience showed image had to be bright enough to show up against Sahara sands or other glaring conditions. G-E lighting engineers were consulted. They quickly produced a new lamp that greatly increased the gunsight's effectiveness. Similarly, G-E has helped solve almost every aviation lighting problem.



3. Working closely with the aviation industry, G-E has produced scores of different aviation lamps . . . from big 10,000-watt airport floodlights to tiny "grain-of-wheat" instrument illuminators. Below are a few in G-E's complete line:

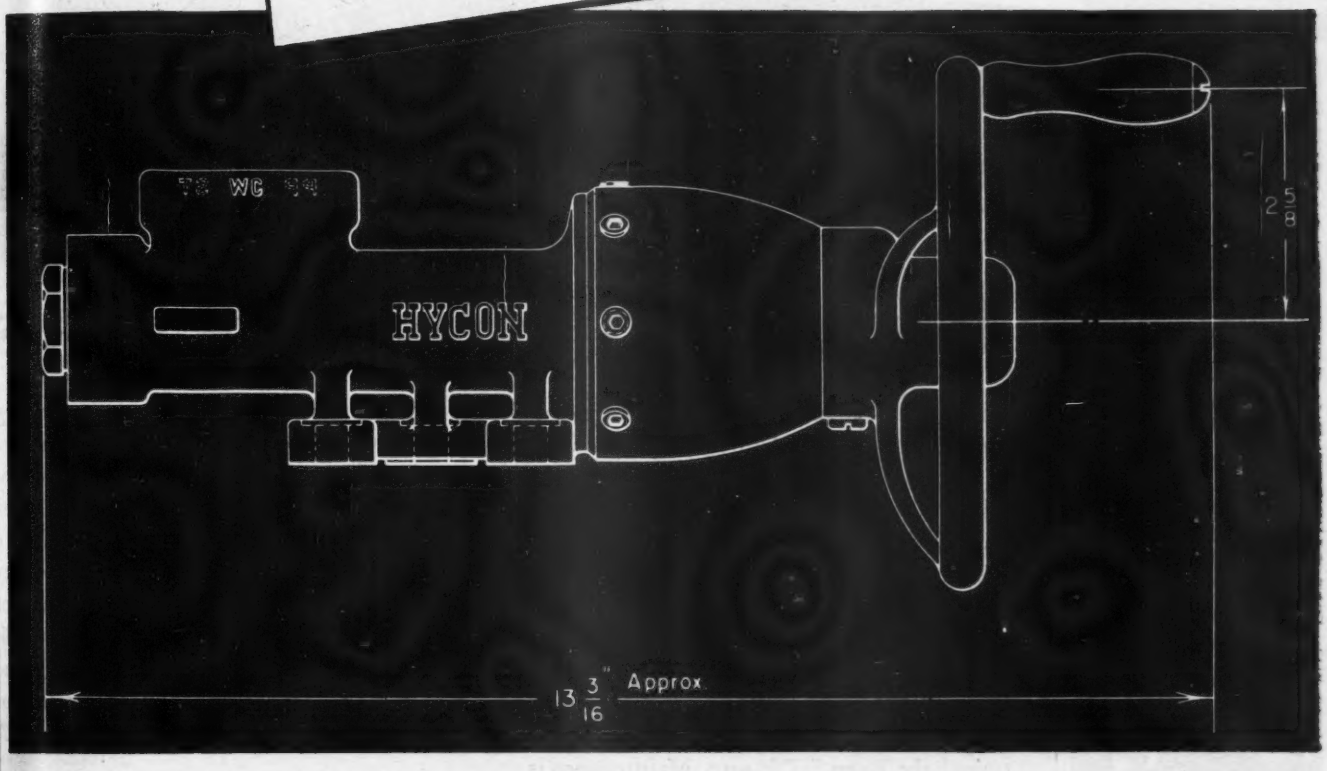
Hear the General Electric radio programs: "The G-E All-Girl Orchestra," Sunday 10 p.m. EWT, NBC; "The World Today" news every weekday, 6:45 p.m., EWT, CBS.

GENERAL ELECTRIC

★ THE BEST INVESTMENT IN THE WORLD IS IN THIS COUNTRY'S FUTURE — BUY WAR BONDS ★

HYCON

HYDRAULIC PRESSURES
Accurately Controlled and Metered



Model 130 Pressure Metering Valve for operation to 3000 p.s.i.

Permits selecting and maintaining any desired pressure from O p.s.i. to full system pressure

Available for Cam ... Hand Wheel ... Hand Lever Foot Pedal Operation

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THE NEW YORK AIR BRAKE COMPANY

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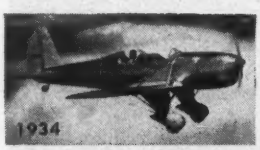
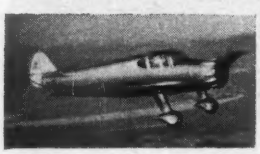
420 Lexington Avenue, New York 17, N. Y.

RYAN-STANDARD cabin plane; pioneer passenger airliner.

RYAN M-1, first production monoplane in America.

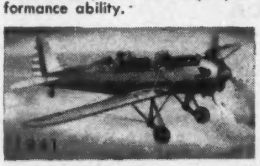


RYAN S-T metal-fuselaged primary trainer; led trend to low-wing types



RYAN S-C, cabin plane for private-owner use, featured all-metal construction.

RYAN YO-51 "Dragonfly", Army observation plane with unique performance ability.



RYAN PT-22, one of Army's standard primary training plane types.

RYAN PT-25, superbly engineered plastic-bonded plywood trainer.

The Ad Customers Wrote for Us

Advertising slogans are often created by advertising men instead of by the reputation of the products they describe. In contrast, the slogan "Ryan Builds Well" was inspired by the proven record of excellent performance and low maintenance of Ryan planes.

A SLOGAN THAT PROVES ITSELF

The head of a War Training Service flying school in the Southwest writes from a base at which Navy pilots are being trained: "As a trainer the Ryan S-T is tops. Maintenance is phenomenally low. Our S-T's have demonstrated they can take the exceptional abuse of flight training programs.... We regard it as the finest intermediate or secondary trainer we have ever used.... Many fighter pilots flying off carriers today can truthfully say they owe a lot to these silver beauties."

Another, the head of large scale training operations in Texas, writes: "... they have continued to be the most satisfactory secondary trainer we have ever used.... Their maintenance definitely outstanding.... We have never received better service from any company.... I believe the high quality of our students has been to a large degree directly attributable to their training in these Ryans.... I am keeping one especially for my own use and for pilot checking purposes."

BUILDING WELL FOR UNCLE SAM

Ryan's current activities include the engineering, development and manufacture of the most advanced type combatant airplanes and important assemblies for the armed services. Publication of detailed information on these is, of course, restricted.

RYAN

Rely on Ryan to Build Well

RYAN BUILDS WELL

Ryan construction, proven in aviation's pioneer days, now proven in war, will tomorrow produce safer, more useful peacetime aircraft.

RYAN TRAINS WELL

Ryan School of Aeronautics, famous peacetime air school, now training fine U.S. Army pilots, follows one creed: Thoroughness.

RYAN PLANS WELL

Modern engineering + flying experience. Typical result: Ryan exhaust manifold systems are now used on the finest planes of other manufacturers.

RYAN AERONAUTICAL COMPANY, SAN DIEGO — MEMBER, AIRCRAFT WAR PRODUCTION COUNCIL, INC.

Ryan Products: Army PT-22s; Navy NR-1s; Army PT-25s; S-T Commercial and Military Trainers; Exhaust Manifold Systems and Bomber Assemblies

Precomputed Sunline Approaches In Celestial Avigation

By **CAPT. JAMES B. REA**
Pan American Airways

Finding a small island in a large ocean is a common avigation problem nowadays, but one must know how to do it—or be lost. The author describes a specialized method used by airline pilots.

THIS ARTICLE presents an accurate and scientific method for making an approach to a given geographical location when only one celestial body is available.

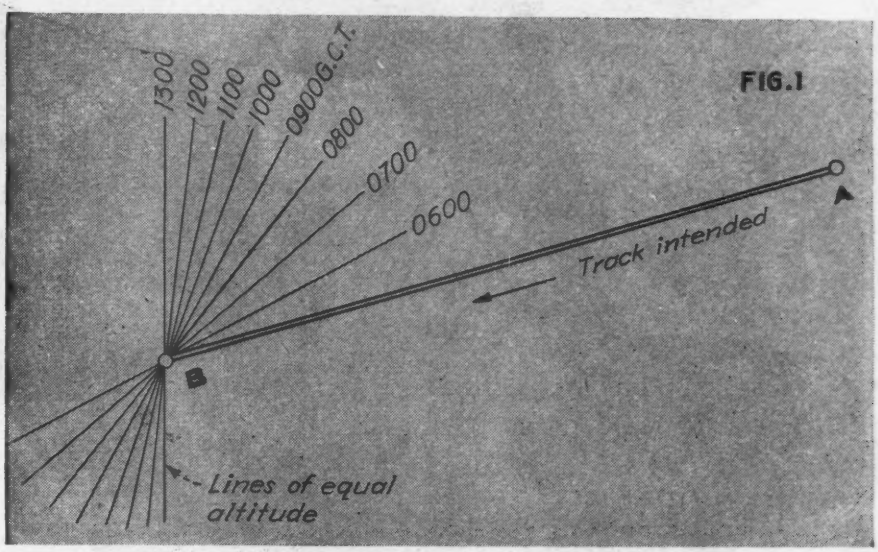
Present-day long-range ocean flights are often terminated by small islands, this being especially true in the South Pacific regions. And sometimes it becomes necessary to approach these islands during daylight hours, with only the sun available for celestial sights. The moon and Venus are not always available for daylight avigation, and if the avigator depends entirely upon radio bearings for his approach he may find at the last minute that he is in serious trouble. His direction-finding equipment may fail, it may point towards large cumulo-nimbus clouds, or it is possible that the "homing" signal may be shut off just when he needs it the most.

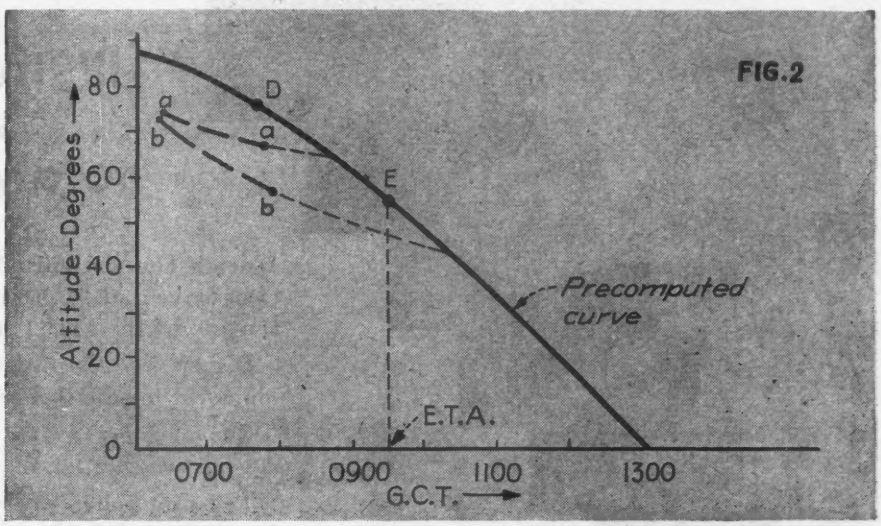
Thus, it can easily be seen that there may be times when an avigator has only his dead reckoning technique and the sun to depend on in finding some small coral atoll located beneath low-lying clouds. The results of his dead reckoning technique are, at most, only as accurate as his knowledge of the winds. And drift sights are not always available.

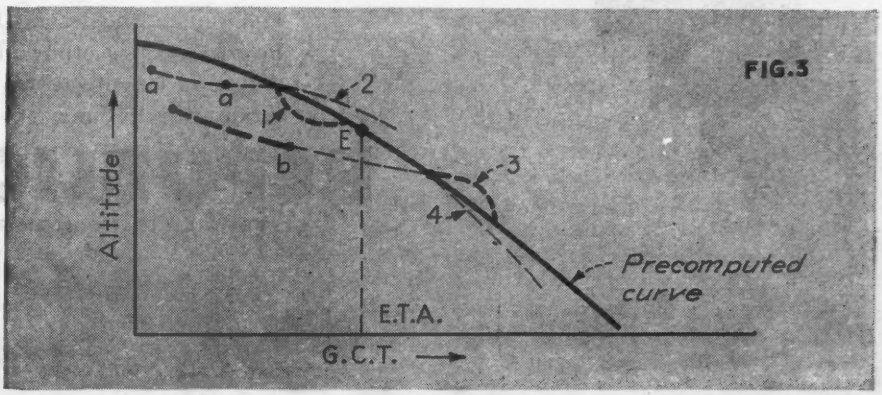
The above arguments have been presented in order to show how important it is for every avigator to acquire an accurate and scientific technique for making a sunline approach. The remainder of this paper will be devoted to the explanation of a method of precomputed sunline approach which has been used successfully on flights over the South Pacific. Simplest way to explain the ideas involved is to present a typical example:

Let us assume (Fig. 1) that you are flying from an island at point *A* to another at point *B* and that the latest dead reckoning information you have indicates that you should arrive at point *B* at 0930 G.C.T. (Greenwich Civil Time). Using the latitude and longitude of point *B*, it is a simple matter to precompute, from the *Air Almanac* and H.O.-214 tables, the directions of lines of equal altitude through point *B*, for a few hours before and a few hours after the estimated time of arrival. These lines should be drawn

(*Turn to page* 334)







"UPSTAIRS" means home to a *Thunderbolt*

When a Thunderbolt pilot "takes her upstairs," he takes her clear to the roof. "Upstairs" to this plane is that area bounded roughly by the 35,000 and 40,000-foot altitude marks.

Biggest job assigned to Thunderbolts today is providing top cover for the bombers battering Hitler's Europe.

The job is being done. See almost any newspaper for convincing evidence.

The stratosphere will be equally important as a sky route for tomorrow's high speed, long distance air transport. Men and women who designed and built the Thunderbolt will know how to put peacetime planes into the stratosphere. Republic Aviation Corporation, Farmingdale, L. I., New York and Evansville, Indiana.

REPUBLIC AVIATION

SPECIALISTS IN HIGH-SPEED AIRCRAFT • MAKERS OF THE

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Thunderbolt

Giving Ground Officers Their Bearings

At Yale they learn the methods and materials of maintenance, armament, photography, and communications—and how to direct men in their future commands who must keep equipment in top fighting trim.

MILITARY

BUILDING THE AAF
PART VI

Down but not out, this *Flying Fortress* becomes workshop where students learn details of airframe construction. These officer-candidates are testing their ingenuity for making replacement parts. (All photos by AAF Training Command.)

By ESTHER FORBES

THERE'S PLENTY OF AAF WORK which "never gets off the ground." And to acquire the know-how for it takes intellectual perseverance—as you would observe if you went to Yale University, New Haven, Conn., where ground crew officers are trained to direct AAF men on battlefronts in maintenance engineering, armament, photography, and communications.

In every tactical unit at least ten enlisted men are needed on the ground to keep each plane flying. In a typical fighter squadron, for instance, there are about 50 men required for the maintenance of armament alone. New Haven supplies the officers. And they supervise the maintenance of equipment, inspect it, and are charged with seeing that it gets into the air.

The four courses given at Yale are of different lengths and quite distinct from each other. However, they have certain broad similarities. Each starts with a week's training in the technical and administrative duties of an officer; each gives an intensive training in all the different duties of the men who will someday be under the student officer's command; and each ends with a week in the principles of field operations, followed by two weeks of practical experience during which cadets live at the New Haven airport and work under simulated battle conditions.

Cadets are chosen in two ways. Some are civilians whose experience records and aptitude tests indicate they will be able to make the grade. Others are enlisted men, recommended by their superior officers for their mechanical skill and qualities of leadership. Choosing cadets from the ranks is greatly preferred by the instructors, who point out that the percentage of washouts is much lower among this group.

To toughen the men before they reach New Haven, they are first sent to basic school at Boca Raton, Fla., for three months of grueling physical training. Many cadets say this is even harder than the rigorous mental work at Yale. Even during their advanced scientific training at New Haven, they are required to spend at least an hour a day in calisthenics or athletics to keep in trim.

The curriculum is arranged in one week phases, and each instructor always teaches the same phase. In order to keep classes small, cadets are divided into two shifts. Classes run six days a week from 6 in the morning to 12 noon or from noon to 6.

This One's Toughest

Of the four courses, maintenance engineering is the longest and has the highest entrance requirements—three years of college training leading to an engineering degree or the equivalent practical experience in civilian life or in the Army. In other words, though they need not have had experience in aviation before, cadets must be capable of absorbing maintenance fundamentals in the 20 weeks' course. Its scope is best realized

132,000,000 BIG ORDERS . . . COMING YOUR WAY

The potential markets of the post-war world are incalculable. We stand on the threshold of an era of new discoveries, great developments, advanced ideas—all to be translated into "things" for better living. Will you be ready to fill your part of this huge order?

The chances are that your problem is one where General Instrument can be of service to you, specifically if your product is in the electronic, communications, aviation or mechanical field.

Our facilities for mass production of precision instruments have been greatly expanded and intensified by wartime achievement. Already we are planning for the reconversion of these resources to the usages of peace. Perhaps your plans and ours may dovetail. Whether it's a modern design for some pre-war product, or the nucleus of a fresh idea, it might be helpful to talk it over with us. May we call upon you for this purpose?

PHONOGRAPH RECORD CHANGERS — HOME PHONOGRAPH RECORDERS — VARIABLE TUNING CONDENSERS — PUSH BUTTON TUNING UNITS AND ACTUATORS.

WAR BONDS—An Investment in Your Country's Future

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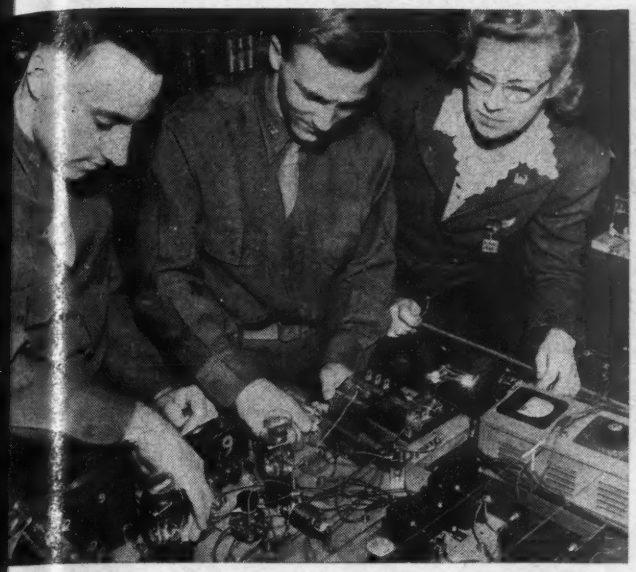

WIRE (Woman Instructor in Radio Engineering) supervises two ainees in their radio work.

Students check a plane's weights and balances on "Loadometer" in order to observe effects of various stowage positions.

considering that while an enlisted n specializes in only one phase of intenance, his superior engineering ficer must be an authority in all phases airframes, engines, propellers, instruents, and electrical, hydraulic, and fuel stems. This actually means that he ust have a knowledge of almost all erations performed by thousands of nployees in an aircraft factory.

After a week in the study of hand ols, cadets begin to learn the struce of American combat planes along ith inspection and maintenance of airames. They learn how to repair every nceivable kind of material used on a lane—from metals such as aluminum, agnesium, and brass to plastic sheet nd textile fabrics used in parachutes nd life rafts. They learn welding of ll kinds, heat treating of different etals, and the use of lathes, milling achines, and contour saws. These ases and the study of power plants ke up the largest part of the course.

The first week's training in engines is ven in one of the newer Yale buildgs. Here, in high-ceilinged rooms with ained-glass windows, cadets learn to ar down, re-build, and repair engines f all types. Later they go to a large door athletic field for more advanced ork in repairing and changing engines n over 20 types of planes, ranging om primary trainers to a Republic *Thunderbolt*.

A unique feature of the maintenance ngineering course is a week's instruction in weight and balance. A group of xperienced combat and transport pilots re sent to New Haven each week to oin cadets taking it. These students xperiment with the distribution of loads n model planes which have been made y the instructors to take into account uch factors as retractable landing gear. Students also learn how to use the load adjuster, a kind of slide rule to determine whether a plane is loaded safely.

For the last two weeks of study, cadets move out to the New Haven airport where they are given the kinds of maintenance problems which may arise at front-line bases. Working in three shifts, 24 hr. a day, no matter what the weather, they take turns acting as enlisted men and officers, thus getting practice both in doing actual repair jobs and in giving orders and inspecting.

To ground crew officer-candidates, this phase of training is what the School of Applied Tactics at Orlando is to flight officers—a dress rehearsal for combat. The airport is divided into areas marked "Bataan", "Corregidor", "Guadalcanal", "New Guinea", and "Wake Island." Everything is designed to approximate battle conditions. As at the front, cadets must always camouflage a plane before starting work on it, and they must be on constant alert with masks ready for a gas raid.

They must also be prepared for action at fields where equipment is lacking. So they learn how to make their

(*Turn to page* 357)

Constructed of canvas, this field darkroom affords student photographers the "blackout" they need to develop their practice shots.

MADE TO THE CLOSE TOLERANCES SET BY THE AVIATION INDUSTRY
UNBRAKO
Reg. U. S. Pat. Off.
INTERNAL WRENCHING SOCKET BOLTS
The high degree of precision demanded by the aviation industry is fully met by "Unbrako" Internal Wrenching Socket Bolts. They are being manufactured in our largest department where equipment is of the finest and workers are highly skilled and experienced in making precision aircraft engine parts. These bolts have the famous "Unbrako" qualities of strength and accuracy while due to their internal wrenching feature they facilitate compact designs and save thereby material, weight and cost.
The new "Unbrako" 100° Flush-Head Socket Bolts, unlike ordinary flat-headed bolts, are made to most extreme accuracy.

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. . . FOR STRENGTH
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urled "Unbrako" Socket Head Cap Screws

The knurled heads prevent time-wasting finger slip and lost motion—help speed production. Knurling also permits locking after countersinking. Sizes: No. 4 to 1½" diameter.

"UNBRAKO" Self-Locking Hollow Set Screws with the Knurled Points

Maintenance, time and money savers. When tightened as usual, the knurls dig in and lock the screws in place so they positively won't work loose under vibration. Sizes: No. 4 to 1½" diameter.

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UNBRAKO Knurled Socket Head Shoulder Screws

are precision ground . . . are extensively used in many places. Great variety of sizes immediately available from stock.

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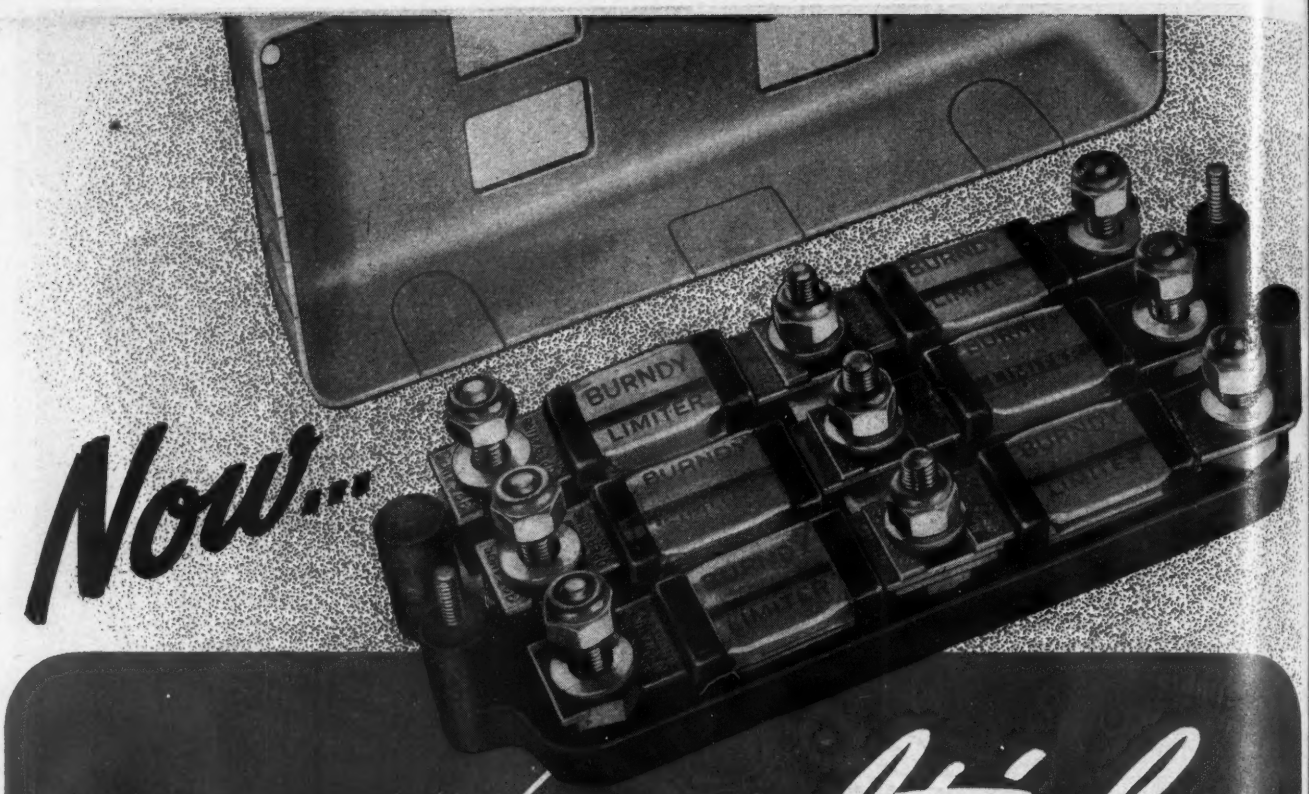

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FOR MULTIPLE PROTECTION AT DISTRIBUTION POINTS!

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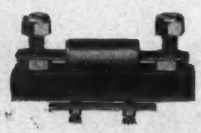

Multiple Limiter panels can readily be combined for additional circuits. Single Limiters still supplied in the usual form.

Now . . . for aircraft networks and radial circuits . . . Burndy adds *new simplicity* in *installing and servicing*, and *new economies in space and weight*, to the *sectionalized protection* which LIMITERS provide against electrical faults.

These new Multiple LIMITER panels are available in units of either 4 or 6 LIMITERS. Circuits, or circuit sections, are quickly wired to the mounted panel; and all servicing is confined to this one point. Furnished with or without covers; the covers available having knockouts for front or side cable entrance. For complete information consult the Burndy representative near you, or write direct.

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NATA and ADMA Hold St. Louis Meetings

CIVIL OPERATION AND TRAINING

Ways to stimulate postwar private plane sales and problems of regulations and war surpluses are discussed by operators, distributors, and manufacturers. Training association adopts more inclusive name.

STREAMLINING OF complicated federal regulations affecting aviation and establishment of a proper government agency to handle distribution of surplus war goods in the postwar period were strongly urged by speakers and leaders at a four-day aviation meeting in St. Louis attended early last month by nearly 600 fixed base operators, dealers, distributors, and manufacturers.

The occasion was the simultaneous conventions of the National Aviation Training Assn., (which changed its name to National Aviation Trades Assn.) and the Aviation Distributors & Manufacturers Assn.

The gathering also saw the growth of a movement, already underway, to set up a system of feeder airlines operated by fixed base operators under a nation-wide consolidated organization.

Roscoe Turner, former speed flyer now operating a flying service and school at Indianapolis and president of Consolidated Air Lines, the operators' feeder line organization, was advanced to the presidency of the NATA from his former post of first vice-president.

Invitation to additional fixed base operators to participate in the feeder airline operations was extended both by Col. Turner and by W. Haley Reed of Kansas City, secretary of the Consolidated organization. Reed said that twelve fixed base operators were already signed up for the feeder lines. Plans call for operation of twin-engine Beechcraft planes, carrying eight passengers and 800 lb. of cargo, over an average of 40 mi. between stops. Stop-to-stop speed would average 120 mph. and cruising 180 mph. Planes will be equipped for pickup service.

Besides Col. Turner, other officers named by NATA were F. Leslie Marsden, Buffalo, first vice-president; Henry von Berg, Carson City, Nev., second vice-president; Leslie Bowman, Fort Worth, retiring president, is new chairman of the executive board. NATA changed its name to National Aviation Trades Assn. to make its membership more inclusive of the industry while still retaining its well known initials, Bowman explained.

Re-elected officers of ADMA were Ray Snyder, Chicago, president; W. F. Scott, Jr., Robertson, Mo., vice-president representing distributors; C. B. Bunch, New York, to newly-created position of vice-president representing manufacturers; George A. Fernley, Philadelphia, secretary-treasurer; and M. E. Galante, Philadelphia, assistant secretary.

R. McLean Stewart, CAA executive director of training, revealed that the end of War Training Service is in sight. By June, he said, the Navy's own training facilities will probably be adequate to handle maintenance of the maximum establishment now attained. AAF Enlisted Reserve training is now a closed program at 56 centers, he reported, and instructor training will be completed with personnel available. After June, Army and Navy will probably not need these centers.

Col. Roscoe Turner, who invited operators to enter feeder service, was elected NATA president.

Need for simplification of flying regulations to make aviation more attractive to the private flyer was urged repeatedly by various speakers, among them Robert H. Hinckley, New York, former Assistant Secretary of Commerce for Air; Leslie E. Neville, editor of AVIATION; Joseph T. Geuting, Jr., New York, chairman of the Personal Aircraft Committee of the Aeronautical Chamber of Commerce; Lt. Col. Earle L. Johnson, national commander of Civil Air Patrol; Representative Jennings Randolph of West Virginia; and Wayne W. Parrish, publisher of *American Aviation*.

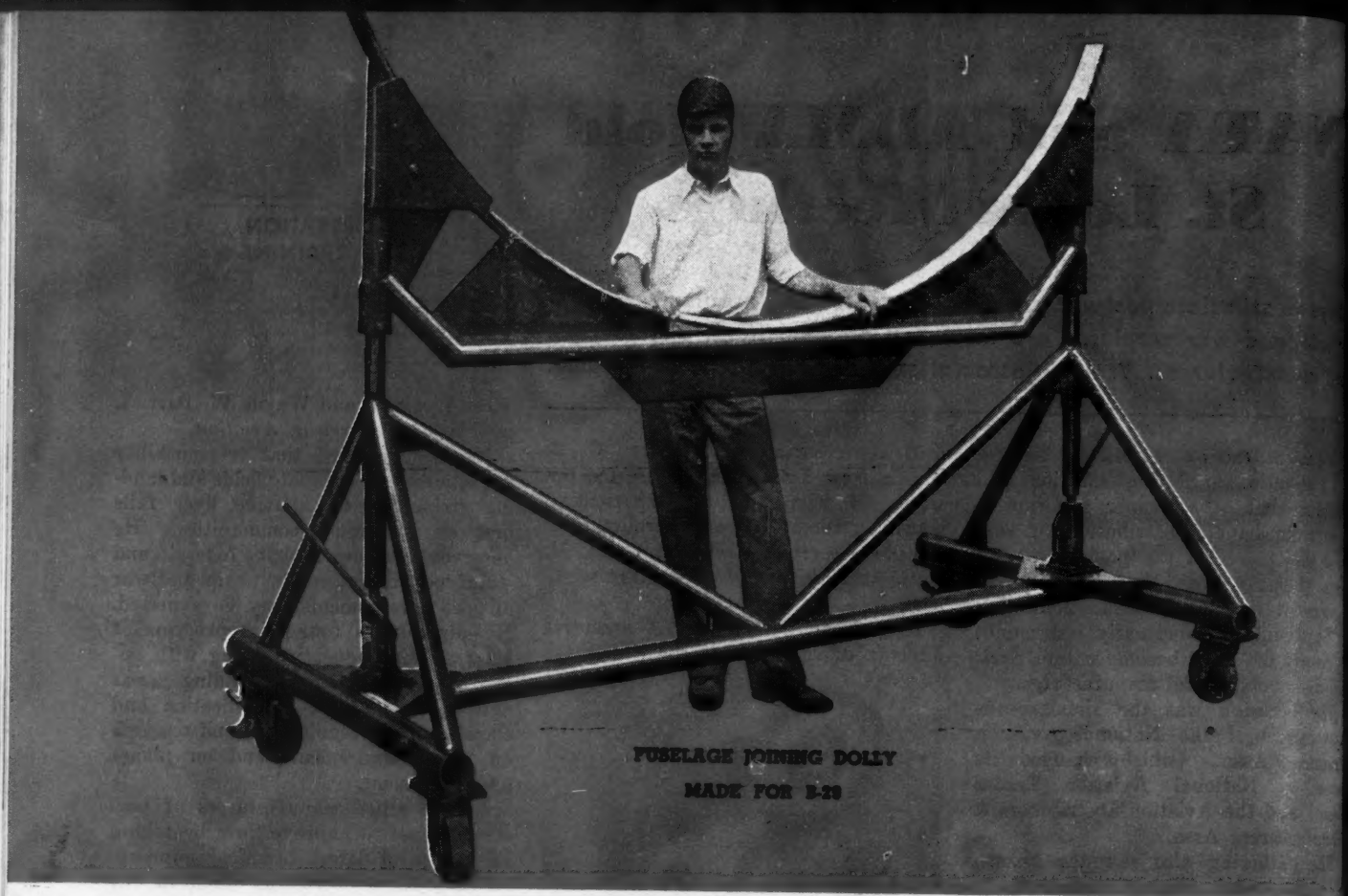
Hinckley warned that responsibility for establishing adequate fields and landing strips for the private flyer falls first on individual communities. He observed, however, that federal and state cooperation in financing postwar airport developments may be expected. He advocated a four-point program of mass aviation education along with improved and additional landing areas and avigation aids, simplification and clarification of regulations, and research on pilot requirements and on planes and equipment.

Neville urged manufacturers of personal planes to improve them by taking advantage of latest technical improvements. He pointed out that in the immediate prewar period some manufacturers had neglected to employ improvements available in order to standardize their planes. He called for more "eye appeal," a new order of salesmanship, improved and reasonable service to owners, and a well-balanced public relations program.

H. P. Ladds, of Cleveland and president of the National Screw & Mfg. Co., presented a proposed plan to distribute surplus materials at the end of the war. He said the scheme is being recommended to Congress by the U. S. Chamber of Commerce. It provides for a seven-man commission, appointed by the President with Senate approval, to take charge of the distribution. The commission will work with advisory committees from the various industries which would be affected by indiscriminate dumping of materials.

Among resolutions voted unanimously were those (1) which opposed the Lea Bill in its present form despite an earlier personal announcement by Bowman in favor of the it; (2) which asked for continuance of federally sponsored civil pilot training after expiration of the present act in June; (3) which called for relaxation of federal restrictions on civilian flying; and (4) which requested that future government regulations be kept simple and easy to understand and at a minimum consistent with public interest.

The annual NATA award for outstanding contribution to aviation was made to Capt. Eddie Rickenbacker, president of Eastern Air Lines.



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Welded Aircraft Components by Certified Weld

FOR SAFE TRAINING

Maj. Gen. Ralph P. Cousins (left), commander of Western Flying Training Command, receives from Lt. Gen. Barton K. Yount, chief of AAF Training Command, "Wings for Victory Award" of National Safety Council "for producing safe and outstanding military pilots." At semi-annual conference of Aeronautical Training Society in Dallas, where presentation was made, Gen. Yount revealed that "accident rate per thousand hours of flying is lower now than it was in 1938 despite tremendous increase in total hours flown."

On Patrol

"As our organization begins its third year of service, the outlook for CAP is more favorable than at any time since we began," said Lt. Col. Earle L. Johnson, national commander, on Civil Air Patrol's second birthday in December. "Strength reports and the great volume of enlistments which are coming in show that the organization is in sound condition and is bigger than ever before." Most important duty now and "for the long pull," Col. Johnson said, is recruiting AAF cadets for acceptance in the enlisted reserve at 17, and then training them before their calls to active duty at 18. To further the recruiting, the Army is distributing among all 48 Wings, in proportion to their strength, 288 new liaison planes. "Flying activities," the national commander reported, "are undergoing expansion. . . Some shifts in our assignments have taken place. Operating bases are now being set up on the West Coast where we could not fly hitherto, and new bases will soon be activated in other areas."

• Recruiting news: Within a radius of 100 mi. of New York City, 3,000 boys have been signed up. Single-handed, one old-timer coraled 100 prospective cadets and made arrangements to instruct them in local school rooms and workshops. . . . Indiana Wing has streamlined the enrollment process. With official permission, its officers are explaining the AAF program, distributing application blanks, and giving candidates mental screening tests in schools on school time. Those who pass this hurdle and preliminary physical examination of CAP physicians are sent to official examining stations where appointments have already been made for them.

• Dispossessed by War Training Service, members of Cedar Rapids, Iowa, Squadron collected enough second-grade lumber and telephone poles to build a hangar 200x28 ft. with 15-ft. eaves clearance. Individual stalls were erected for planes so their owners could get them in and out without disturbing other ships.

• Barracks at Bowman Field are being lent weekends to Kentucky Wing for cadet training by CAP officers.

Along the Apron

• American Airlines has sponsored an organization known as Air-Age Education Research to promote public understanding of the implications, possibilities, and problems of air transport through preparation of study materials for schools, colleges, and the general public. Director of this new liaison agency between technicians and the public will be Dr. N. L. Engelhardt, Jr., recently educational consultant to CAA in the preparation of its high school texts. Other members of the advisory board include Dr. Alexander J. Stoddard, superintendent of Philadelphia schools, Dr. Edwin A. Lee, dean of school of education, University of California at Los Angeles, and Dr. Ben M. Cherrington, director of the Foundation for the Advancement of Social Sciences.

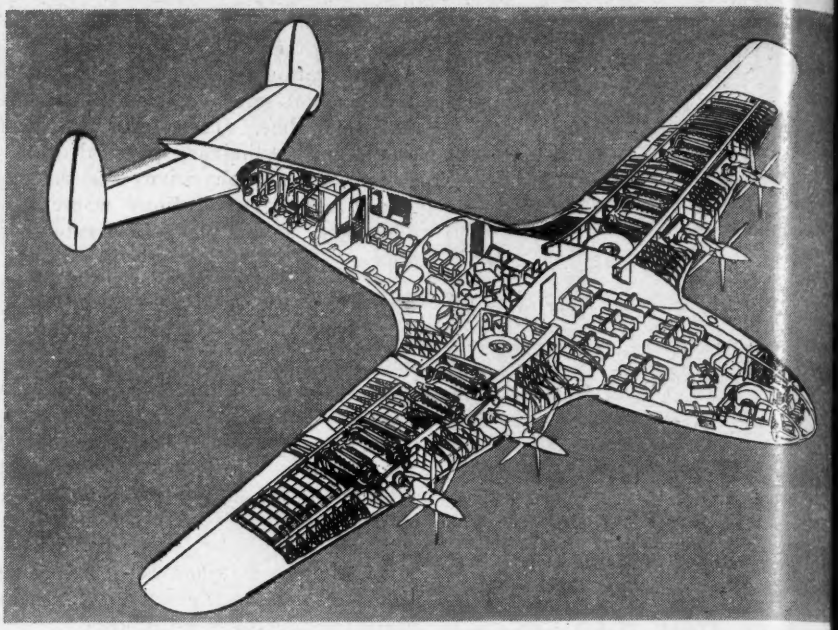
• Navy's 17 flight preparatory schools and 90 CAA war training schools, including six for flight instructors, are now under control of Naval Air Primary Training Command. Headquarters are at Fairfax Airport, Kansas City, Kan., and commanding officer is Rear Adm. Elliott Buckmaster. Primary training, except for cadet procurement, is thus integrated under one jurisdiction. Since 1942, Adm. Buckmaster reports, length of training time has been extended from 12 to between 16 and 18 months. Procurement announces that 17- and 18-yr.-old high school seniors who will graduate this June can now enlist as cadets.

• Airport locations are among objects of local civic geography shown on transportation and industrial map prepared by Cincinnati Chamber of Commerce.

• Ohio State has named the 400-acre airport it now has under construction after Capt. Don Scott, AAF, 100th former student to die in this war.

"REEF" FOR A HEAVY BLOW

Concrete pyramids, with notches for tail wheels and ropes to hold them in these blocks, are part of outside mooring system for light planes devised by Hawthorne Flying Service, WTS operators at Columbia, S. C., municipal airport. Front wheels rest to within 1 in. of their axles in additional blocks, and wings are tied to rings embedded in ground. Result is zero angle of attack and minimum lift in heavy winds. Fence (left) is preliminary windbreaker.



Cut-away drawing of proposed Miles *X* passenger and cargo carrier. Power would be delivered by eight 1,750 hp. Rolls Royce engines faired into wing and geared in pairs to contra-rotating propellers. This design, by F. G. Miles, has been presented to British Air Ministry by Phillips & Powis Aircraft, Ltd., best known as builder of Miles *Master* and *Magister* single engine training planes.

Plans of Miles "X" Transport Revealed

In bid for postwar business, Phillips & Powis Aircraft presents design for eight-engine passenger-cargo plane to British Air Ministry.

ADDED EVIDENCE that Great Britain intends to make every effort to obtain a place in postwar air transport is given by announcement of plans for the Miles *X*, a 130,000-lb. gross weight passenger and cargo carrier.

Design for the craft has been submitted to the Ministry of Aircraft Production by Phillips & Powis Aircraft, Ltd., builder of the Miles *Master* and *Magister* training planes.

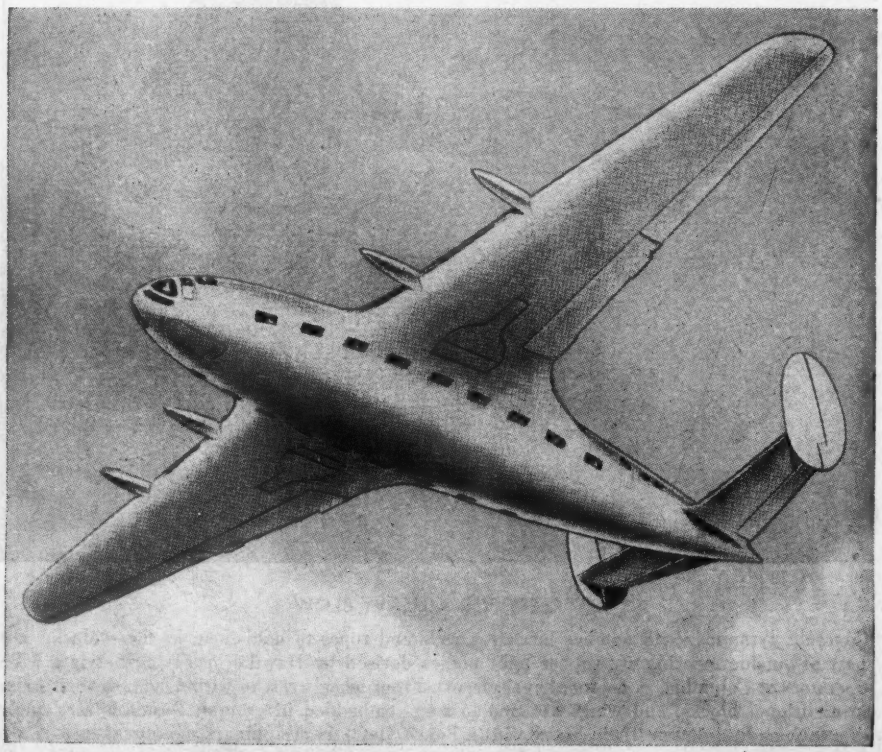
According to preliminary plans, the craft will be powered by eight 1,750 hp. Rolls Royce liquid cooled engines buried within the wing and geared in pairs to four six-blade, contra-rotating propellers. Performance anticipated would be Range of 3,450 mi. against 50 mp headwind at 350 mph. cruising spee Accommodations: 50 passengers an crew of five.

Basic design, it is said, is such tha it can be adapted as both a short an medium range plane to carry 100 pa sengers with a range of 2,000-2,500 mi or an unspecified number with an opera tional range of 1,100 mi.

An unusually wide cabin is provide in the design, the maximum cross sec tion being 16 ft., with a height of 8 ft giving a total volume of 6,000 cu. f This would permit alternative seatin arrangements. In one arrangement, fo example, three cabin sections could b provided—a main lounge forward wi 34-passenger capacity, a midships cab for a "dining and recreation room" and an aft cabin for rest rooms or 16-passenger smoking room. In th medium range version, seats could b arranged in two rows of three seats eac on either side of a 4 ft. x 60 ft. aisle.

The unusual volume of the cabin held to give the design particular ad vantages for freight carrying, since

(*Turn to page* 343)

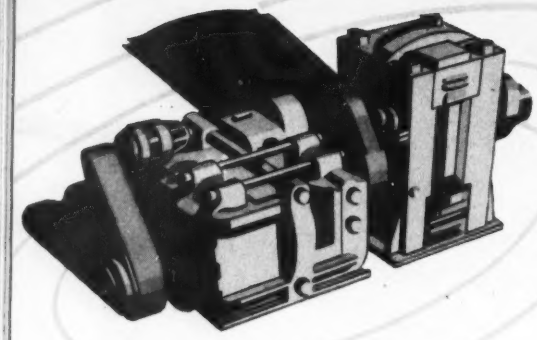


With 16-ft. wide cabin, proposed Miles *X* transport would permit varied passenger-seating arrangements, while 8-ft. height would allow loading of bulky packages if plane were used as cargo carrier. For long range operation, plane is designed to have maximum range of 3,450 mi. against 50 mph. headwind at cruising speed of 350 mph. Medium range operations—2,000-2,500 mi.—would call for crew of 5 and 50 passengers.

Pearl Harbor!

BY JAMES M. SESSIONS

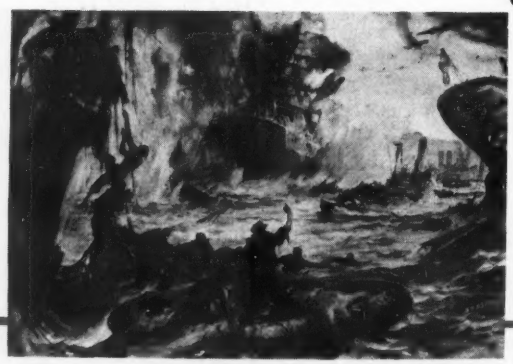
NO. 1 OF A SERIES "HIGHLIGHTS OF WORLD WAR II" PRESENTED BY TUBE TURNS (INC.) LOUISVILLE, KY. SEE OTHER SIDE



WARTIME FORGINGS WIDEN *Tomorrow's* USES

Mechanical warfare—and the gruelling punishment that war machines undergo—has demanded the strength and characteristics of forgings in many unheard of applications. Out of this acid test have come new conceptions of forgings as a metal form. New uses, new types, new metals, new manufacturing accuracy, new design economies—found and proved through the urgency of war production—open interesting vistas to design and production engineers.

What we have to offer—now and after the war—goes beyond our array of large upsetters, mechanical presses and heat treating furnaces. You will find here an unfettered viewpoint, a willingness to tackle new forging problems that can prove useful in your design or production today or tomorrow. ***Tube Turns (Inc.), Louisville, Ky.***



Tube Turns presents on the reverse side of this page the first of a series of stirring war paintings created by the well known contemporary artist, James Sessions. "Pearl Harbor" is Sessions' conception of the catastrophe that aroused America.

TUBE TURNS

Forgings for Industry

KEEP POSTED ON

Products & Practices

This selected information on new publications and products is offered by the "AVIATION" Reader's Service through cooperation with the manufacturers. It helps executives save invaluable time, provides profit through convenience. To obtain literature or additional data on new products described, simply fill in form below,* clip it to your letterhead, and mail. There is no cost, no obligation.

ENGINEERING DATA

Silver Babbitt 1

Bulletin and engineering briefs on silver babbitt, being produced on basis of research by Battelle Memorial Institute, have been prepared by National Bearing Metals Corp., St. Louis. Institute reports that this war substitute is composed of silver alloyed with balanced lead-base babbitt.

Glue Recommendations 2

Wall chart—*Glue Recommendations for U. S. Government Specifications*—has been reissued in enlarged form by Casein Co. of America, New York City. It lists requirements and suggested binders for making some 57 articles.

Indium Properties 3

Literature issued by Indium Corp. of America, New York City, contains charts on chemical and physical properties of indium, technical description on using it in plating, its history, and some of its present applications.

Magnesium Processing 4

Machining, welding, forming, riveting, and surface treating of magnesium is shown in technical film. For showing before scientific groups, it is available from Dow Chemical Co., Midland, Mich.

Pipe, Tube Bending 5

Copper & Brass Research Assn., New York City, has prepared handbook on practical methods of bending pipe and tube of copper, brass, and related alloys. Given are specifications and weights of these materials, and instructions, drawings, and illustrations on forming them.

Insert Fasteners 6

Data on Rosan locking system of threaded inserts and locked-in studs for fastening in non-metallic materials issued by Bardwell & McAlister, Hollywood, Calif., includes cardboard model of insert with moving section showing operating principle; bulletin illustrating applications of these fasteners; design data sheets with cut-away drawings of various installations; specifications; and questionnaires to be filled out by manufacturers desiring recommendations on fastenings.

Chain Belts 7

Engineering Handbook No. 67—Aviation Div., Baldwin Duckworth, Springfield, Mass.—shows design of machine-finished roller chains and their use in aircraft controls. An accessories section covers terminals and connectors.

PRODUCTION

Screw Charts 8

Comparator charts, inscribed on plate glass ¼ in. thick, are being produced in 57 ranges by Universal Engraving & Colorplate Co., Buffalo. Literature prepared by company has illustrations and prices of several models.

Welding Electrodes 9

Callite Tungsten Corp., Union City, N. J., is distributing Bulletin No. 154 on applications of its tungsten electrodes to atomic-hydrogen, helium, and argon arc welding of aluminum, duraluminum, nickel, and chrome, monel metal, copper, molybdenum and stainless steels, copper, brass, and bronze.

Manufacturing Hints 10

Recent issue of war production data collated in booklet by E. F. Houghton & Co., Philadelphia, contains short, illustrated articles on prevention of rust by displacing water and on machine lubrication and blackening of steel propeller blades.

Finishing Materials 11

Felt wheels and bobs, industrial felts which can be cut to fit special jobs, steel wool, powdered and lump pumice for polishing copper, wood, and plastics, abrasives and rouges, and sponges and chamois are described and illustrated in use in bulletin being circulated by James H. Rhodes & Co., Chicago. Company also announces new type lining for pilot's goggles, shin straps, and sweat bands; perspiration is said not to harden it.

Rust-Proofing 12

"Corronizing," new rust-proofing process developed by Standard Steel Spring Co., Coraopolis, Pa., is explained in booklet. Process involves electroplating thin layers of corrosion-resistant metals on base stocks.

Surface Inspection 13

Features, specifications, and use of "profilometers" for measuring surface roughness of metals are given in booklet prepared by Physicists Research Co., Ann Arbor, Mich.

Gage, Tool Service 14

Merz Engineering Co., Indianapolis, depicts in bulletin four types of service now offered to industry: Design and research engineering; mass production of standard plain and threaded plug and ring gages; design and production of special gages and tools; and volume manufacture of parts.

AVIATION READER'S SERVICE JAN.
AVIATION, 330 W. 42nd St., New York 18, N. Y.

Please send me additional information according to key numbers circled.

INFORMATION TIPS:						1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
NEW PRODUCTS:					49	50	51	52	53	54	55	56	57	58	59	60	61
62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	

NAME..... TITLE.....

FIRM OR AFFILIATION.....

ADDRESS.....

Plates, Irons, Edges 15

Leaflet distributed by Barco Scraping Co., Cleveland, gives features and dimensions of company's surface plates, angle irons, and straight edges. Firm announces that they are hand-scraped to .0002 in. flatness.

Grinding Belts 16

Advantages of swing frame grinding with abrasive finished cloth belts (in which belt and drive motor are suspended over work) are listed in folder from Behr-Manning, Troy, N. Y.

Saws & Sawing 17

Data on metal sawing and various types and styles of saws offered by Clemson Bros., Middletown, N. Y., are contained in company catalog No. 43-S. Emphasized are selection and blade cutting speeds for different metals, use of hack saw frame together with list of firm's blades, frames, power and band saws. An affiliate company, Victor Saw Works, also of Middletown, has also issued instruction book and sales catalog (No. 43-V) on its line.

Stainless Steel 18

Jessop Steel Co., Washington, Pa., has published catalog of its stainless-clad steel. Included is information on analyses, applications, fabrication, manufacture, head styles, and sizes of sheet and plates available; also sections on deep drawing, grinding, polishing, gas-cutting, cleaning, riveting, welding, and soldering.

MACHINERY & ACCESSORIES

Heavy-Duty Finishers 19

Paper binders for loose-leaf data book prepared by W. F. and John Barnes Co., Rockford, Ill., illustrate and give applications of various machine tools including those for multiple drilling and reaming, boring and facing, milling, and deep hole cutting. Data sheets have also been prepared.

Machining Aids 20

Recent leaflets issued by Doall Co., Des Plaines, Ill., describe firm's Saw Eez for facilitating contour cutting, steel ink for layout work, cutting oils, grinding wheels, and abrasive bands for contour machines.

Positioner, Trimmer 21

Welding positioner, which can be built to user's requirements, and a new stamping trimmer, which forms, beads, trims, and flanges large and small stampings, are shown in bulletins Nos. QW 115 and 116, respectively, from Whiting Corp., Harvey, Ill.

Hook Checker 22

For determining whether thread milling and other cutters have been sharpened to correct angle of hook or rake and flute spacing, new hook checker is available. Description, instructions, and specifications have been compiled in Bulletin No. HC-43 from Detroit Tap & Tool Co., Detroit.

Hydraulic Apparatus 23

Power units, presses, and test benches are among hydraulic apparatus for machine tool and aviation work pictured and described in new loose-leaf catalog *Hydraulic Machinery*. It has been prepared by Hydraulic Machinery, Dearborn, Mich.

Machine Tools 24

Gisholt Machine Co., Madison, Wis., illustrates in new catalog its ram and saddle turret and automatic lathes, its machines for balancing and other special work, standard tools and chucks, and a speed selector.

Dip Tanks 25

Leaflet No. 511, Aeroil Burner Co., West New York, N. J., lists features of new portable, electrically heated dip tanks which have two compartments.

Speed Reducer 26

Stephens-Adamson Mfg., Aurora, Ill., gives specifications, engineering drawings, uses, and features of its speed reducers in Catalog 643.

Back Stand 27

New Model ABS back stand idler for doing grinding work with power supplied by polishing and grinding lathes has been put on market by Porter-Cable Machinery Co., Syracuse, N. Y. Its operation and specifications are given in broadside prepared by company.

Bearings 28

Uses of forged steel bearings in aircraft instruments and engines are shown in booklet distributed by New Departure Div. General Motors Corp., Bristol, Conn.

Miller 29

Operating features of its Model 33 Fluid-Screw Rigidmil milling machine manufactured by Sundstrand Machine Tool Co., Rockford, Ill., are shown in booklet. Specifications and engineering drawings are also given along with description of hydraulic control of table screw.

Protective Surface 30

Uses of "Ucilon," resistant surfacing material which can be applied by brushing, spraying, or dipping are shown in booklet prepared by manufacturer, United Chromium, Inc., New York City.

Staplers 31

Illustrations, descriptions, and applications of stapling machines in aircraft work are contained in bulletin offered by Heller Co., Cleveland.

Rubber Goods 32

Fiftieth anniversary catalog of Manhattan Rubber Mfg. Div., Passaic, N. J., shows firm's line of industrial rubber goods including friction materials, coverings, and abrasive wheels. Technical data and engineering information are given on hose and tubing along with history of company and presentations of some articles designed for postwar markets.

Presses 33

Wide line of hydraulic straightening and bending presses manufactured by Watson-Stillman Co., Roselle, N. J., is pictured in Bulletin No. 320-A which also contains table of capacities in tons.

Riveter 34

Independent Pneumatic Tool Co., Chicago, issues folder showing mechanical features and operation of its pneumatic rivet driver. It is designed for use with Goodrich Rivnuts and has light indicating when fastener is properly upset.

Beads & Flares 35

Aluminum tubing to ¾ in. o.d. and .065 in. gage can be beaded and flared, it is announced by Vaill Engineering Co., Waterbury, Conn., on its No. 6 machine shown in broadside. A single handle controls operation and moving parts are shielded in Plexiglas.

AIRCRAFT

Cargo 36

Reprint of article, Packaging and Handling of Air Cargo, read before SAE meeting by its chief engineer, C. G. Peterson, has been made available by Railway Express Agency, New York City.

Filters 37

Purolater Products, Newark, N. J., has charted flow rates and pressure drops and embodied them with specification drawings and descriptions of its filters for various aviation uses in handbook titled *Aircraft Hydraulic Filters and Elements in Accordance with Specification AN-F-3.*

CO_2 Devices 38

Booklet published by Walter Kidde & Co., New York City, shows features and installations in aircraft of carbon dioxide fire extinguishing systems and other air and oxygen lifesaving apparatus.

Runway Ice 39

Skid-proofing and ice removal are topics briefly considered in information sheet, *Ice Control for Airport Runways*, distributed by Calcium Chloride Assn., Detroit.

Tubing 40

Booklet on flexible stainless steel hose for aircraft installations has been pre-

pared by Chicago Metal Hose Corp., Maywood, Ill. Data is offered on specifications and capacities of various sizes, flanges and fittings, their design, and line loss. Similar information is also given on bellows.

ELECTRICAL

Commutator Cleaner 41

Leaflet of Industrial Power and Equipment Co., Pittsburgh, Pa., lists features of commutator cleaner made of nonconducting abrasive mounted in wood hand holder. One available size has face 1¾x¾ in.

Relays 42

Guardian Electric Mfg. Co., Chicago, has issued broadside for quick engineering reference in selection of relays and solenoids. Known as Bulletin OF112, it has descriptions, contact ratings, power requirements, sizes, and weights of 17 types of relays.

Splicing Terminal 43

Making of connections with solder-less splicing terminal which hooks with knife-like blades is illustrated in Bulletin 27, published by Aircraft-Marine Products, Harrisburg, Pa. Tables give dimensional information for various installations.

Mikes, Etc......44

Microphones and receivers, relays, solenoids, and switches are included in items listed by Automatic Electric Co., Chicago, in Catalog 4071-D. Items are fully described by photos, specifications, installation information, engineering diagrams, and charts of stock assemblies are provided.

Coil Calculator 45

Calculating coil winding and resonance data is reported speeded by use of new slide rule. Device is produced by Allied Radio Corp., Chicago, which has issued sheet describing principles of the calculator's operation.

PLASTICS & MATERIALS

Felt Samples 46

Line of SAE felts, coated with rubberized compounds, resins, etc., have been mounted on sample card in 16 grades. American Felt Co., Glenville, Conn., reports these combinations for fuel tank mountings, grommets, gaskets, etc.

Plastics Information 47

Industrial Magazine Service, New York City, announces publication of *Plastics in Aircraft*, booklet containing articles on engineering properties of plastics, their applications in aircraft, physical properties of laminates, and design considerations.

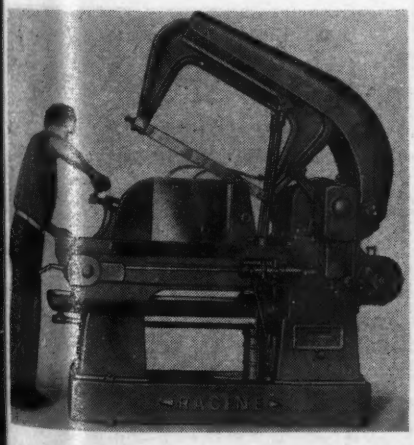
Plywood & Veneers.....48

Price and stock list of wide variety of plywoods and veneers ready for shipment from its Chicago warehouse is being distributed by Aetna Plywood & Veneer.

Latest Machine Tools

Metal Cutter 49

Model No. 36-C metal cutting machine manufactured by **Racine Tool & Machine Co.**, Racine, Wis., has capacity of 20x20 in on metals including die block steel. Light weight blade is said to make few chips, thus resulting in savings in multiple cutting. Full control of hydraulic operation is maintained through single lever. Through dual feeding, fast cutting speed can be obtained on light materials and predetermined rate on die blocks, alloys, and tool steel. Speeds of 55 to 85 and of 115 strokes per min. are delivered from 3 hp. motor through transmission consisting of V belts and twin disk clutches. Other specifications: Capacity at 45 deg. 20x14 in., length of blade stroke 6 in., blade length 30 in., height 78 in., width 48 in., and shipping weight with motor 5,760 lb.—AVIATION, *Jan.*, '44.



Air Compressor 50

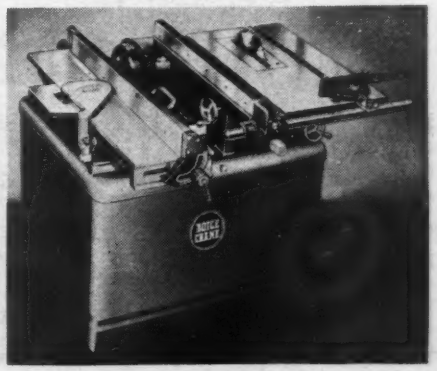
Water-cooled, single-stage, double-acting industrial air compressor which requires small block foundation is available from **Sullivan Machinery Co.**, Michigan City, Ind. Valve assemblies can be easily inspected, and truncated piston design is reported to give large head and valve radiation areas. Automatic stopping and starting controls are optional.—AVIATION, *Jan.*, '44.

Hack Saw 51

Announced as "world's largest hack saw machine," new cutter has capacity of 25x26 in., weighs 10,000 lb., occupies floor space 56x122 in., and stands 12 ft. 7 in. high. It was designed for work on forgings, blocks, billets, and shafts and is known as model No. 24 Marvel. Current required to operate its three motors totals 6½ hp. Moving parts are enclosed, and blade measurements are 36x4½x⅛ in. Its steel teeth and alloy body are credited by **Armstrong-Blum Mfg. Co.**, Chicago, with contributing to long life.—AVIATION, *Jan.*, '44.

Saw & Jointer.....52

Into one steel floor stand, **Boice-Crane Co.**, Toledo, has combined 6-in. jointer and 10-in. tilting arbor saw. Both are powered by same motor. Jointer has long work table and special front and rear fence locks.—AVIATION, *Jan.*, '44.



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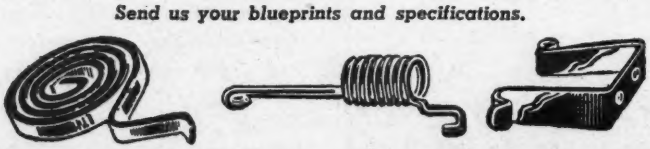

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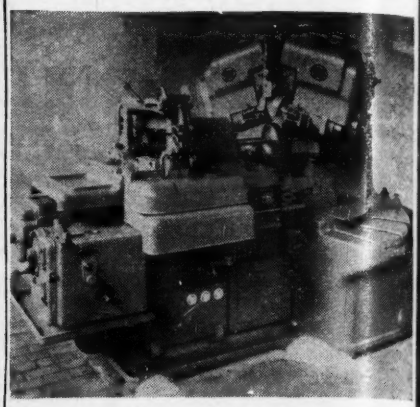
Gear Grinder 53

Cosa Corp., New York City, American agents of Maag Co., Zurich, announces availability of new Model HSS-30 grinding machine for hardened and ground gears. Grinding operation is done by two saucer-shaped wheels which require



no coolants and adjust themselves for wear. Production tolerances are given as no more than .0002 in. on pitch and .00012 in. on profile. Arbor will grind several gears simultaneously, and machine can run continuously, making one part after another.—AVIATION, *Jan.*, '44.

Carbide Grinders 54

Improvements incorporated into new line of carbide tool grinders are reported as: 1. Wide-mouthed, fully adjustable coolant spouts and larger splash pans to keep floor dry; 2. Safety cup disk—which moves with hood and table as wheel wears—to prevent tools from accidentally dropping into cutting well; 3. Concealed, swiveling wheel guard shielding one side of wheel while other is in use; and 4. Tilting tables replacing wear plates between table slot and wheel. With flexible water connections and only two screws holding guard hood, removal of wheel is simplified, reports **Hammond Machinery Builders**, Kalamazoo, Mich. Machines are offered in 10 and 14 in.

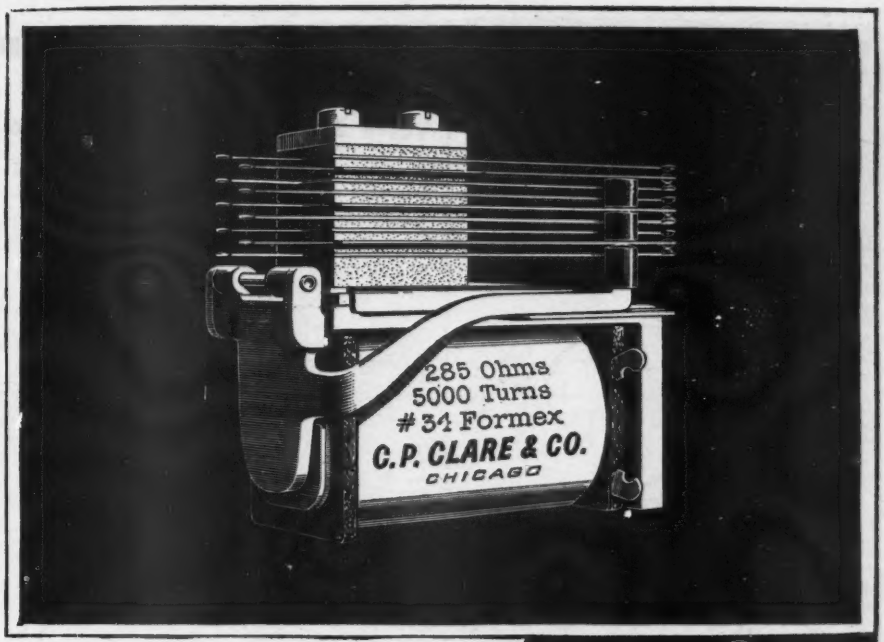
sizes, respectively powered by 2 and hp. motors which are fan-cooled and can be reversed. Other equipment includes compound protractor tool gage, wheel dresser holder, and coolant tank with pump for wet grinding. — AVIATION, *Jan.*, '44.

Band Filer 55

Doall band filing machine is available for broaching metals, alloys, plastics, fiber, and wood following previous preparation by sawing, nibbling, burning, stamping or casting. Pressure and filing speeds are under operator's continuous control, and finished tolerances are stated to be as low as .001 in. File bands are provided in widths of ¼ to ⅝ in. in ovals, half-rounds, and flats. Unsnapping band and threading work

through it permits internal filing. Machine itself is welded steel with 15½-in. throat capacity and 6-in. thickness capacity. Worm gear transmission is wholly enclosed, according to **Continental Machines**, Minneapolis. Variable speed pulleys give range of 50 to 150 ft. min. Lamp provided can be set at any angle, and blower close to work clears chips away.—AVIATION *Jan.* '44.

Announcements of new machine tools and shop equipment and accessories are invited for inclusion in these columns. In writing, emphasis upon aviation industry applications of newly-marketed items is desirable, and, wherever possible, glossy-print photos should be enclosed for illustration. (Please do not send electros). Manufacturers should address New Products Editor, AVIATION, 330 W. 42nd St., New York 18, N. Y.



VIBRATION?
SHOCK?
EXPOSURE?

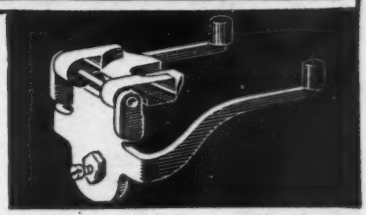
This CLARE TYPE G RELAY Withstands Them All

This Clare Type G Relay has come through the rigorous tests of war with flying colors. Its many applications on aircraft, where shock and vibration are constant, include radio equipment, compasses and controls of various kinds.

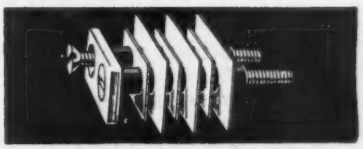
Clare Type G is a short coil relay — just 2½" x 2¼" x 1¼" and weighs but 6½ ounces. Coils are carefully wound to exact turns on precision machines. They are protected with a transparent acetate covering and are available impregnated with special varnish.

Exposed metal is plated to withstand a 200 hour salt spray test. Special Bakelite insulators of heat treated Bakelite keep moisture absorption below Army and Navy requirements. These also possess minimum cold flow and permit punching without cracks or checks. Type G can be provided with 12 different types and sizes of contacts which are welded to the nickel silver springs by a special process. This provides for effective dissipation of heat.

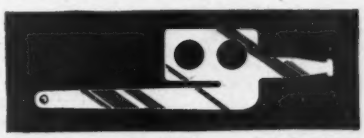
Every Clare Relay is built of the finest materials and under precise manufacturing conditions. Each is "custom-built" to the exact specifications your design calls for. Put your relay problem up to our engineers. Send for the Clare catalog and data book. C. P. Clare & Co., 4719 Sunnyside Avenue, Chicago (30), Illinois. Sales engineers in all principal cities. Cable address: CLARELAY.



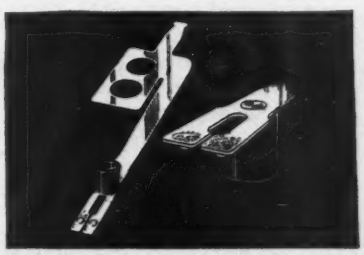
Double arm armature assembly of stainless steel shaft, operating in a marine brass yoke. Heelpiece, core and armature assembly of magnetic metal.



High voltage spring pile-up insulators of special heat treated Bakelite. Has minimum cold flow properties, low moisture absorption content; and permits punching without cracks or checks.



Contacts are welded to nickel silver springs by special process. May be of precious metals or alloys in 12 different standard, or special, types and sizes.



Spring bushing insulators are made of Bakelite rod under patented process. Resist vibration and withstand heavy duty service.

CLARE RELAYS

"CUSTOM-BUILT" Multiple Contact Relays for Electrical, Electronic and Industrial Use

...with **X-RAY**

...the modern way to "know" what you're getting

A New England war plant, purchasing steel castings from an outside source, was experiencing a reject rate of 75% *after* machining. Each reject meant a loss of 3 machine and man-hours. Solution: X-ray inspection to "spot" defective castings *before* machining. Result: 100% real production from same men and machines . . . tremendous savings in materials. Another example of how Westinghouse X-ray takes the "guesswork" out of industrial inspection . . . speeds production and cuts costs.

J-02022

More Information?

See page 265

Westinghouse

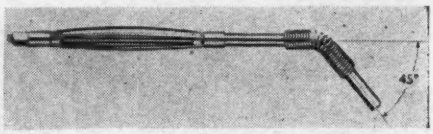
X-RAY

PLANTS IN 25 CITIES...OFFICES EVERYWHERE

Shop Equipment and Accessories

Valve Guide Cleaner 56

Flexible shaft permitting 45 deg. bend is incorporated in new attachment for cleaning gasoline deposits from valve stem guides. Rigid models are also available. Type MF-302 shown has



seven blades and can be adjusted between 7/16 and 5/8 in. Four other sizes manufactured by **New Britain Machine Co.**, New Britain, Conn., permit adjustment range from 5/16 to 1/2 in. with five blades up to 31/32 to 1 5/32 in. with 13 blades.—AVIATION, *Jan.*, '44.

Plotter 57

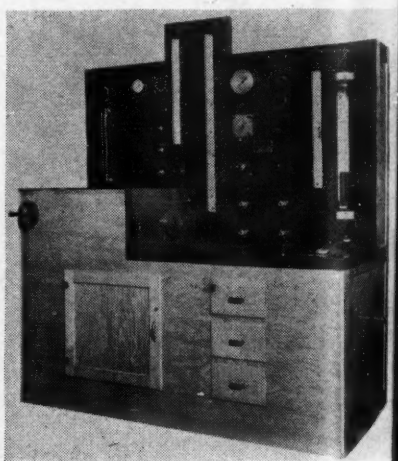
For **Jardur Import Co.**, New York City, Hugh Thomasson, senior avigator, American Export Airlines, has designed avigating plotter and protractor for plotting celestial lines of position. It is to eliminate need for dividers, parallel rules, and is made of transparent plastic. Device is small enough to be slipped into pocket.—AVIATION, *Jan.*, '44.

Runway Magnet 58

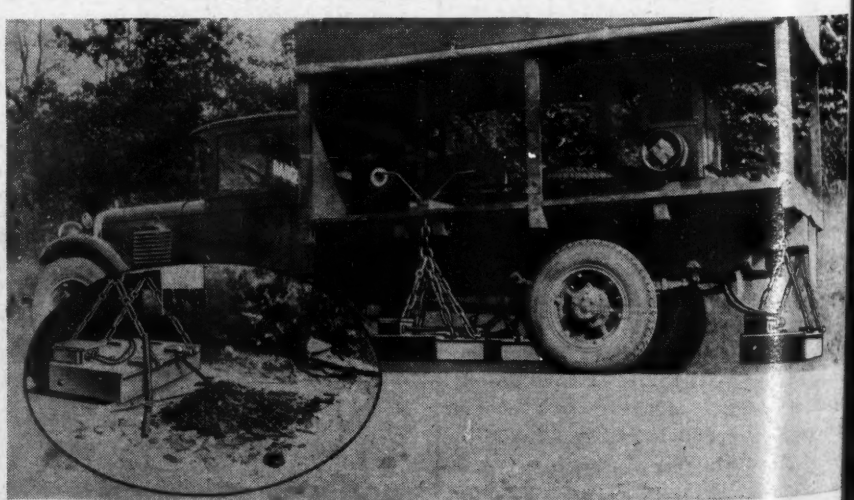
Adaptable for removing nails and other small metallic impedimenta from airport runways, magnets manufactured by **Cutler-Hammer**, Milwaukee, can be mounted on truck and powered by ordinary farm generator set. Path cleared is 8 to 9 ft. wide. Suspended 2 to 3 in. over ground, magnets are reported to have power enough to pick up subsurface nuisances.—AVIATION, *Jan.*, '44.

Test Bench 59

New testing unit announced by **Liberty Motors & Engineering Corp.**, Baltimore, is intended for checking aircraft hydraulic and vacuum pumps. Latter can be observed at speeds from 700 to 5,200 rpm.; input suction and output pressures are read directly in inches of mercury. Orifice chamber and water manometer indicate air flow up to 50 cfm. On hydraulic pumps, which can be tested within same speed range, input suction is also read in inches of mercury, output pressure on gage registering up to 4,000 psi. Flometer indi-



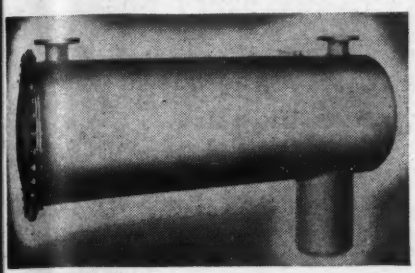
cates rate of hydraulic fluid from 1 to 12 gpm. Two-speed reversible 15-hp



motor is connected through transmission providing additional variations. Temperature of oil in reservoir is maintained automatically. Consumption of vacuum pumps can be judged with meter tube and electric clock. Sink is incorporated in top of unit to catch oil leakage. Necessary adapters and accessories are included.—AVIATION, *Jan.*, '44.

Water Separator 60

Gasoline entering new separator first passes through coalescing medium which breaks down any water emulsions. Water then is discharged through accumulator where it is drawn off by automatic valve. When large globules of water collect,



pumping system shuts down, stopping delivery of fuel to plane. Separating material can be removed when saturated with foreign matter, but this is reported necessary only when considerable pressure develops. This apparatus is reported by **Warner Lewis Co.**, Washington, D. C., to be "guaranteed to deliver gasoline containing not more than 1-500 of 1 percent of undissolved water." Models are made in capacities from 25 to 1,000 gpm. and for Diesel fuel and kerosene.—AVIATION, *Jan.*, '44.

Gage Surfacing 61

Micronil is name of new protective liquid coating that can be applied with a brush to gages, dies, and punches. **Protective Coatings**, Detroit, reports that it "lubricates in surface rather than on it." Freezing is said to be eliminated even in parts with millionth tolerances. Chrome-plated and carboloy units respond favorably.—AVIATION, *Jan.*, '44,

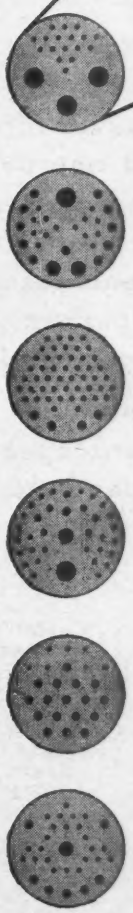
Tube Sealing 62

Development of a new thermo-plastic dipping process for tube sealing and surface protection, termed "Plastalloy," is announced by Vultee Field Div. **Consolidated Vultee Aircraft Corp.**, Plastalloy seals are quickly applied and removed, and material may be reclaimed and used indefinitely. To seal tubes, ends are dipped into melted plastic to depth of ¼ in. Plastic adheres to open-

CANN ON

STANDAR IZATION

Shown below are six of the thirty-eight available contact arrangements in the LK diameter.



MEANS greater assembly speed!...faster servicing!

The hundreds of shapes and sizes of Cannon Connectors have many parts that are readily interchangeable, making thousands of possible combinations. This interchangeability of parts means greater assembly speed . . . faster servicing.

Stock Cannon Connectors are in use in a wide variety of industries. So great is the diversity that it is difficult to find a requirement in the field of general industry which cannot be met with a standard Cannon product.

The Cannon Catalog Supplement gives a resume of the Cannon Connectors for general use. Drop us a line on your business letterhead and we'll gladly mail you one. Address Department A-110, Cannon Electric Development Company, Los Angeles 31, California.

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Cannon Electric Development Co., Los Angeles 31, Calif.

Canadian Factory and Engineering Office: Cannon Electric Company, Limited, Toronto

CANNON ELECTRIC

REPRESENTATIVES IN PRINCIPAL CITIES—CONSULT YOUR LOCAL TELEPHONE BOOK

ing as a tough, durable film that withstands rough handling. It can be removed with fingernail. A 2-qt. electrically heated pot with either manual or thermostatic control to maintain 145 to 150 deg. C. is recommended by Convair engineers as a reservoir for material. Its other uses include protection of finished surfaces and delicate threads on machined parts and for temporarily attaching loose parts to assemblies. Tubing seals have been calculated to cost approximately one mill each on the basis of dipping twenty ends per minute, and reclaiming 50 percent of material.—AVIATION, *Jan.*, '44.

Balancer **63**

Rights to manufacture of balancing machines developed by Gyro-Balance Corp. have been acquired by **Sonntag Scientific Corp.**, Greenwich, Conn. Sonntag says machine "differs from conventional balancing machines in that it directly measures added alternating bearing forces exerted by unbalance of

rotor rather than tangible displacement of balancing parts. Alternating unbalance forces are transmitted by a practically rigid platform to quartz crystals

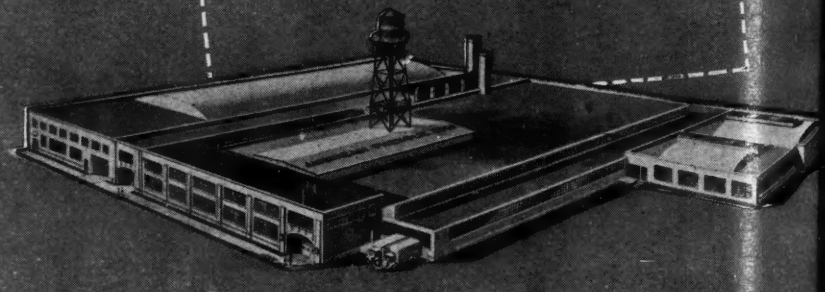
Building

• Building today in unlimited quantities the vital electrical and high frequency equipment for practically every phase of the war effort, Amphenol, with this experience is also anticipating the great future of the electronics industry.

New and unusual types of connectors—new and more efficient wiring systems for high frequency currents—new and improved applications for polystyrene and other plastic insulations—these and many other products of Amphenol research will set new standards of performance, economy, and service in postwar industry.

Now, for electrical war equipment—later, for peacetime applications—you can depend upon Amphenol quality.

The Amphenol Catalog and Handbook lists and describes Amphenol A-N Connectors, High-Frequency Coax and Twinax Cables, and other Radio and Electrical Products. A request on your letterhead will bring your copy.



AMERICAN PHENOLIC

For the Future

OF ELECTRONICS··

"A-N" CONNECTORS

Army-Navy specification electrical connectors, manufactured in every required size and type by Amphenol, are made for many applications—in electrical and communications systems of airplanes, tanks, ships—for special applications in the field of electronics. The use of Amphenol Connectors assures dependable service.

AMPHENOL "A-N" CONDUIT AND FITTINGS

Flexible aluminum and synthetic covered conduit to A-N specifications. Amphenol A-N specification conduit fittings include: ferrules, coupling nuts, adapters, cable clamps, straight and angle couplings—all necessary fittings for complete conduit assembly work.

LOW-LOSS TRANSMISSION LINES

Amphenol Coax and Twinax Cables with ultra low-loss Copolene B or beaded type polystyrene represent the ultimate in high frequency transmission lines—their use assures the uniform low-loss characteristics required in high frequency or micro-wave installations. Used with Amphenol Type 83 Coax and Twinax Connectors for perfectly balanced assemblies.

AMPHENOL POLYSTYRENE

Clear, transparent Amphenol polystyrene—custom machined with special equipment under ideal production facilities—will save you waste and worry in fabrication. The useful combination of properties characteristic of this material offers unlimited advantage in the field of electronics. Also Amphenol polystyrene rods, sheets, and welding cement (Polyweld).

COMPLETE CONDUIT AND WIRING ASSEMBLIES

At the Amphenol plant, you find one of the most modern and complete wiring assembly departments. New equipment, specially trained operators, new approved methods—turn out complete Amphenol cable assemblies, wiring harnesses, conduit assemblies—with speed and accuracy at moderate cost.

ILLUSTRATED:
Amphenol Coax and Twinax Cables equipped with Amphenol Type 83 Connectors. Machined Polystyrene and other plastic products. Amphenol AN-3108 Connector with Amphenol Flexible Aluminum Conduit.

Depend upon AMPHENOL Quality

CORPORATION • CHICAGO

IN CANADA:
AMPHENOL LIMITED • TORONTO

producing piezo-electric potentials which are magnified by vacuum tube amplifiers and made visible on screen of a cathode ray oscillograph. Magnitude of unbalance ultimately expressed in ounce-inches or depth of drilled or milled holes is indicated as a sine wave pattern, representing magnitude and location of unbalance. . . . Standard models up to 75 lb. rotor weight for speeds up to 12,000 rpm. are available." Machine illustrated is intended for gyro rotors.—AVIATION, *Jan.*, '44.

Nibbler..... 64

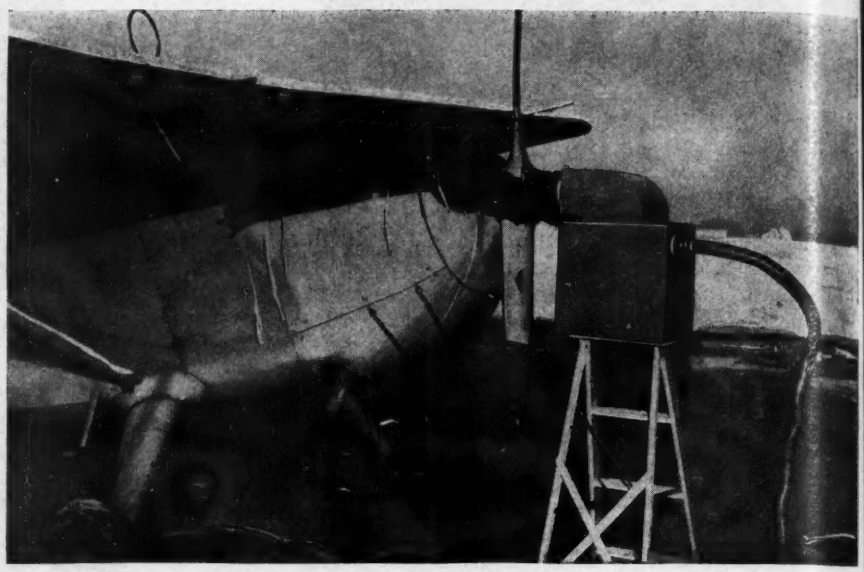
Hand-operated nibbling tool developed by **National Machine Tool Co.**, Racine, Wis., is designed to cut any shape template and trial blank in reduced time, cut drill rods $\frac{1}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, and $\frac{3}{8}$ in. dia., and punch holes up to $\frac{1}{2}$ in. through $\frac{1}{8}$ in. flat

stock. Body of machine is cast steel and wearing parts hardened and ground. —AVIATION, *Jan.*, '44.

Test Sets..... 65

Two types of units for testing aircraft bonding, contact resistance of relays, circuit breakers, and radio equipment are being produced by **Shallcross Mfg. Co.**, Collingdale, Pa. Type 645 has full scale range of .005 to .5 ohms; this is called Army range. Navy range is .003 to .3 ohms full scale. In both units, wooden container holds meter, batteries, and switches. This case can be slung over shoulder of operator who attaches clamp to one side of subject surface and probes other with contacts embedded in pistol-shaped grip. Possible recording of bond or contact resistance measurements runs as low as .0001 ohms.—AVIATION, *Jan.*, '44.

W. T. S. OPERATORS!



You'll Like This Quick Preheating for Trainers with a Hunter Low Cost "Cold Starting" Heater

Gets them in the air quicker . . . Burns any type of gasoline, fro truck fuel to highest octane . . . Fuel supply self-contained . . . Compact, simple and dependable . . . Can be operated anywhere within reach of 110 volt extension . . . Easily handled by one man . . . Can be hooked up or stowed away in a few seconds . . . Delivers 25,000 Btu per hr. . . . Unit shown above specially designed for light planes. Other simple duct connections available for larger cowls or for radial installations. Comes with complete set of ducts and harness for either type of installation. • Investigate this simple preheater before cold starting time losses interfere with your contract operations.

BULLETIN HB-3 ON REQUEST

HUNTER AND COMPANY

Aircraft Equipment

1550 E. 17th St.

CLEVELAND • OHIO

HUNTER HEATER READIES MOTOR IN FEW MINUTES ON COLDEST DAY

Quick-on Duct Connections Permit Easy Set-Up of "Cold-Starting" Device

BURNS ANY TYPE OF GASOLINE

CLEVELAND, OHIO—Details of a gasoline heater made by Hunter and Company of this city for preheating aircraft engines quickly to starting temperatures in severe weather have recently been released for general distribution. Advantages claimed for the Hunter device are its lightness, simplicity of construction, the ease with which it can quickly be set up and taken down, and the fact that it operates on any type of gasoline at hand.

The Hunter preheater, weighing approximately 45 pounds, delivers 25,000 B.t.u. per hour and re-circulates heated air through the engine housing by means of flexible ducts. This makes it possible to pump hot air over a cold engine in sufficient volume to bring it to starting temperature in a matter of minutes, even in sub-zero weather.

Flexible ducts are provided which connect the heater to the breather openings of an engine cowl, as shown in the illustration. These are so designed that they can be quickly attached with the aid of a simple harness provided with the equipment. Allowance is made for variation in sizes and types of cowl. Special hoods are available for delivery of heat to radial installations.

Rapid heating and recirculation of the air within the enclosed area assures even heating of all parts of the engine. Thus when the intake manifolds have been brought to proper temperature, the oil sump, cylinders and valves also are preheated to a degree that assures prompt action of the lubrication system when the engine starts.

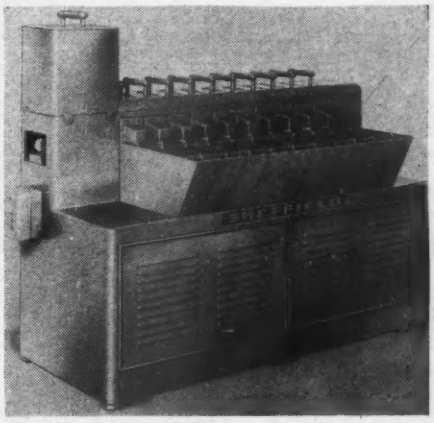
This simple heater can be detached from the flexible ducts and set inside a plane cabin, or used to blow hot air over an area where mechanics are working in low temperatures, or for a number of special services.

Complete information on the Hunter Preheater may be obtained by writing or wiring Hunter & Co., 1550 E. 17th Street, Cleveland, Ohio.

(Advertisement)

Bearing Sorter..... 66

For classifying ball bearings according to size, **Sheffield Corp.**, Dayton, Ohio, has produced machine to handle sizes from ⅛ to 1½ in.. When they are placed in hopper, walking beam moves them over successively larger openings which can be adjusted in increments of .00005 in. Small balls are thus rejected immediately and those too large remain at end of line after all others have dropped through their proper holes. As long as operator keeps hopper filled machine sorts automatically at a rate reported to be much greater than was previously obtainable by other methods. —AVIATION, *Jan.*, '44.

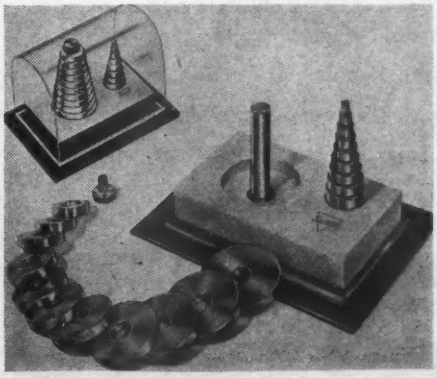


Cable Loops..... 67

Sizes for 3/32, ⅛, and 5/32 in. cables are provided in new line of loop fittings intended to replace usual splices in non-flying controls. These fittings "permit application of loading stresses in a line that is parallel to and coincident with axis of cable," according to maker, **American Chain & Cable Co.**, Detroit. Aim is elimination of possibility of unequal stresses.—AVIATION, *Jan.*, '44.

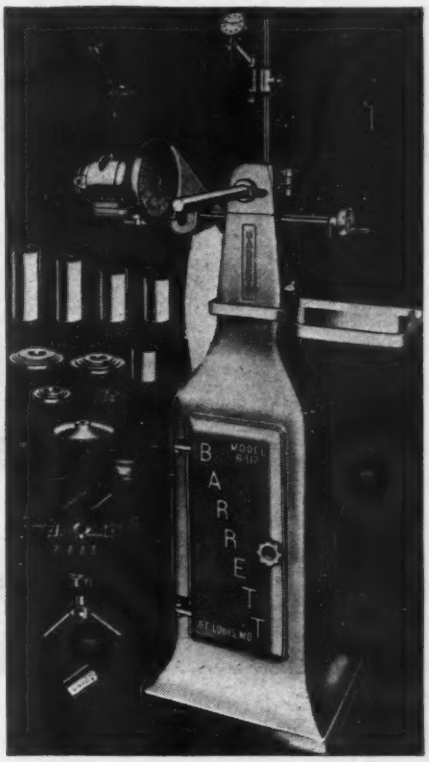
Checking Rolls..... 68

For testing micrometers and snap gages, new set of 20 setting and checking rolls has been introduced. Rolls, in sizes from .100 to 2.000 in. dia. are hardened, ground, and lapped as well as being deep frozen before finish grinding. They are kept on stems in transparent plastic case also supplied by maker, **Sav-Way Industries**, Detroit, —AVIATION, *Jan.*, '44.



Brake Servicer..... 69

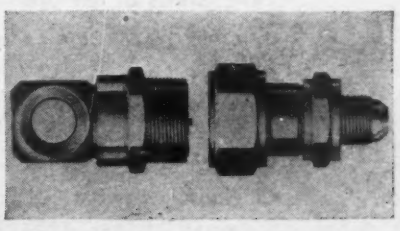
Specially adapted for aircraft use, brake servicing machine can be used while brakes are on landing gear or still on production line. It is designed to



tailor lining to proper drum size. Photo, issued by **Barrett Equipment Co.**, St. Louis, shows Model B-117 and accessories supplied with it.—AVIATION, *Jan.*, '44

Coupling..... 70

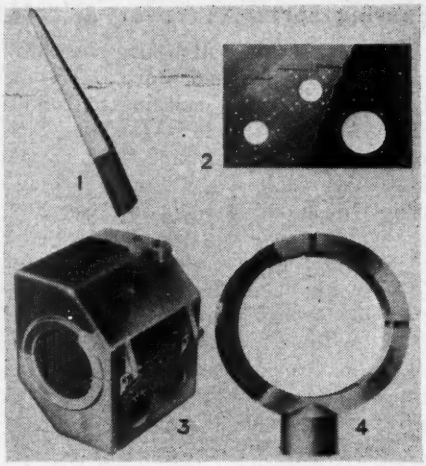
Finger-tightening is said to be sufficient to make this coupling withstand 2,500 psi. Its aluminum alloy body is called strong enough to prevent jamming heat-treated spring shut-off valve. Pop-



pets are light cast phenolic. Synthetic gasket is provided along with option of AAF or AN threads. Maker is **American Screw Products**, Los Angeles.—AVIATION, *Jan.*, '44.

Electroplating..... 71

Photo illustrates applications of electroplating metal on plastics and nonconductors, a process developed by **Metaplast Corp.**, New York City. Fig. 1: Combat plane attena mast of electroplated Compreg wood; Fig. 2: Instrument panel on which shielding can be plated to any desired thickness; Fig. 3: Plastic swivel-joint housing on which copper and cadmium have been deposited thus saving material otherwise required for an all-metal unit; Fig. 4: Polystyrene antenna loop showing how plating process covers coil an arc of which is still exposed in left portion.—AVIATION, *Jan.*, '44.



ACW Alloy Bars

in Ryerson Stocks

• Aircraft quality 8630–X 4130–4140 alloy steel bars — hot rolled, cold finished and heat treated — in a wide range of sizes — are carried in stock for immediate shipment from Ryerson plants at Chicago, St. Louis, Cincinnati and Jersey City. These steels conform to specifications: AN-S-14, AN-QQ-S-684, and AN-QQ-S-752 respectively and are readily available to aircraft manufacturers and their subcontractors under the ACW program. A special booklet of stocks on hand, "Aircraft Alloy Steels," will be sent to you on request.

Other steels at ten Ryerson plants comprise over 10,000 different kinds, shapes and sizes — everything in steel. Call your nearby Ryerson plant first — for quick action on steel. Joseph T. Ryerson & Son, Inc., Steel-Service Plants at: Chicago, Milwaukee, St. Louis, Detroit, Cleveland, Cincinnati, Buffalo, Boston, Philadelphia, Jersey City.

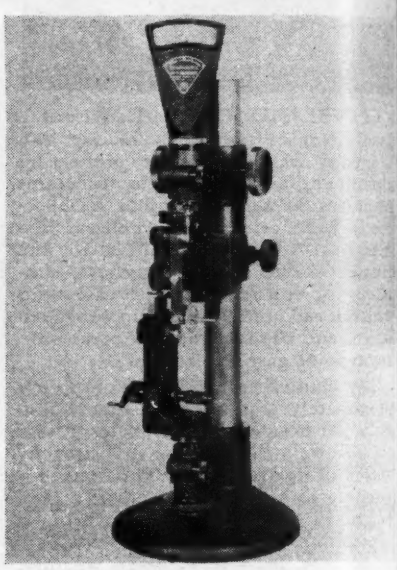
RYERSON STEEL-SERVICE

Diamond Hone..... 72

Machine tool carbide and other type hones with diamonds held in tungsten carbide matrix and equipped with handles are being sold by **Tungsten Alloy Mfg. Co.**, Newark, N. J. Three surface grades are offered, 100, 150, and 200 grit.—AVIATION, *Jan.*, '44.

Gear Tester..... 73

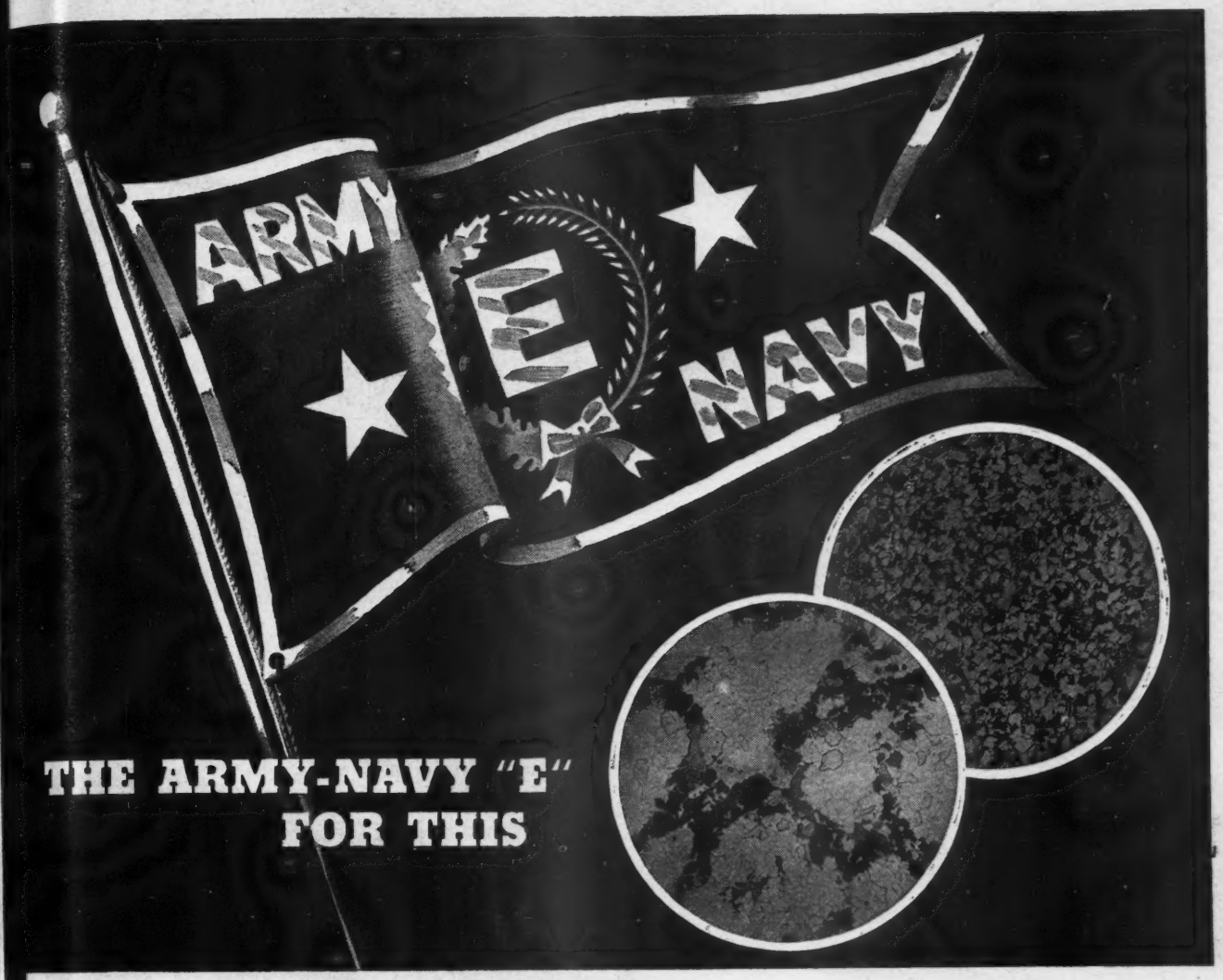
Errors and faults in gears which can be detected by new checker include those of rolling action, eccentricity, variation in tooth thickness, and poor spacing. Center distance can be obtained in range of 1 to 6 in. by use of gage blocks or standards. In other instances, master gear is placed on arbor where it comes in contact with sample. Counterbalance between them maintains constant pressure. Rotating control pinion turns



both gears; divergence or error can be observed on comparator head which can be adjusted to read to .001, .005, .0025, and .0001 in. Device is development of **George Scherr Co.**, New York City.—AVIATION, *Jan.*, '44.

Coating Solution..... 74

Iridite is name of new solution for protective coating of zinc and cadmium surfaces made by **Rheem Research Products**, Baltimore. It is reported to soak into metal when it is immersed for 10 to 60 seconds; bending, forming, or twisting do not break its surface which itself does not alter dimensions of the coated material. This product, it is stated, is not affected by 100-hr. salt spray; 100 gal. is considered sufficient to cover 20,000 sq.ft. of metal surface—AVIATION, *Jan.*, 44.



THE ARMY-NAVY "E" FOR THIS

On September 5th, 1942, our Mine and Mill at Climax, our Research Laboratory at Detroit and our Conversion Plant at Langeloth, Pennsylvania, were given the Army-Navy Production Award. Since then the award has been twice renewed. The two-starred flag we fly represents a full year of contribution to the war effort recognized by the Army and Navy.

Winning the award by the laboratory began in 1931. It was then that it was founded to meet our needs for authoritative information about molybdenum—containing ferrous materials.

Pearl Harbor intensified our work with producers of war equipment—work that is aided considerably by the accumulated data and experience gained in over ten years of concentrated research.

We are particularly proud to be among those companies whose laboratories are entitled to fly the Army-Navy "E".

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company

500 Fifth Avenue · New York City

MOLY

Both planes and finishes on naval patrol and utility duty, have to be "good sailors" . . . taking their flying weather as they find it. Rain, fog, sudden temperature changes, tropical sun and corrosive salt air are all alike to the amphibians. Finishes for such versatile planes have to be tough, durable and long-lasting. That is why the specifications read "Berryloid."

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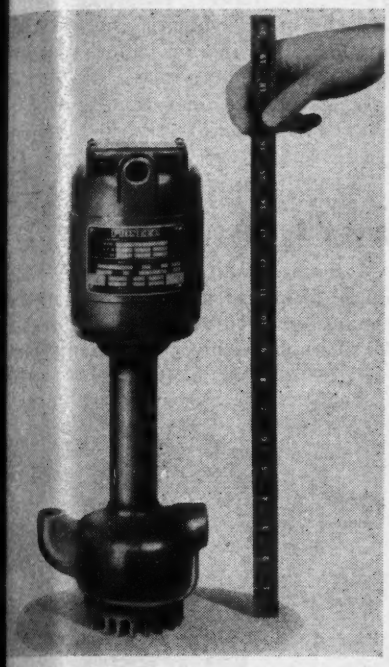
AIRCRAFT FINISHES

mp Pump..... 75

About 16 in. high, new coolant pump de by **Pioneer Pump & Mfg. Co.**, troit, is intended for base sumps or parate coolant tanks on such small chines as hand mills, surface and in- rnal grinders, drill presses, and tap-



ng machines. Brackets and flanges e provided for mounting on edge, side, top of outside separate tanks. Chips all enough to penetrate bottom grille ill also go through whole mechanism ithout damaging it.—AVIATION, *Jan.*, 4.

onduit Wrench..... 76

Ratchet is feature of wrench for tight- ning conduit with knurled or serrated ttings, plugs, and tubing. Wrench can e used for turns in either direction. s jaw encircles part, then a shoe slides

orward to make firm contact. Product being marketed by **Joyce & Associates**, os Angeles, in sizes for all standard ircraft fittings.—AVIATION, *Jan.*, '44.

ew Synthetic..... 77

United States Rubber Co., New York ity, announces development of a sixth ype of synthetic rubber known as Thiokol. Its possible uses may include pplications in which fuels, oils, and

Auburn

CERAMIC SPARK PLUG CONNECTORS

a gremlin IN SIZE

AUBURN

a giant IN IMPORTANCE

Only 1 inch long, 1/12th of an ounce in weight, but it packs a powerful punch in Aircraft Engine performance.

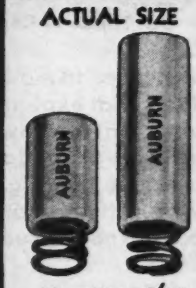
The Auburn Ceramic Connector is a vital unit, assuring constant contact between Ignition Cable and Spark Plug. The Vitreous porcelain sleeve combines high dielectric and heat - resistant qualities. It will not carbonize, carbon-track or absorb moisture. Two sizes serve all applications.

Auburn Connectors have won official approval and acceptance.

Write for complete details.

AIRCRAFT DIVISION
AUBURN SPARK PLUG COMPANY, Inc.
1180 Raymond Blvd. Newark 2, N. J.

ACTUAL SIZE



No. 1041 — 9/16"
No. 1099 — 1"

AUBURN SPARK PLUG COMPANY, Inc.
MAIN OFFICE and FACTORY, AUBURN, N. Y.

Learn About These Improved Compounds for Cleaning Metals Now!

During the past two years MAC DERMID INCORPORATED has perfected and had approved for war production innumerable variations of ANODEX and METEX compounds that are so far ahead of previous metal cleaning compounds that they are already considered an important factor for improved post war planning. Let us have one of our qualified service representatives help you with your post war planning — show you the many new compounds that have been formulated for the aviation industry — prove to you the advantages to be derived from using compounds manufactured by specialists, *individually formulated for specific cleaning problems.*

Write and Be Right

We'll be pleased to mail you these informative, new folders that explain the many new METEX compounds that are now available for speeded up, exacting war production . . . tell you how to electro-clean the original ANODEX way and thereby save time, materials and manpower. Just drop us a note on your business letterhead.

COMPOUNDS FOR *Every* CLEANING PROBLEM

MAC DERMID
INCORPORATED
WATERBURY 88, CONNECTICUT

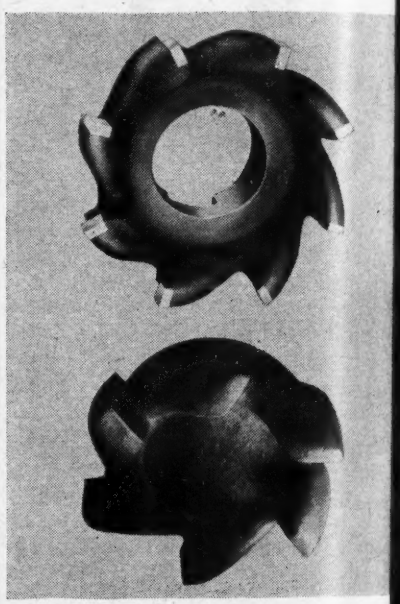
WRITE ONE OF THESE SERVICE ORGANIZATIONS FOR FREE DEMONSTRATION

NEW YORK Udylite Corp. (L. I. City) · DETROIT Udylite Corp. Wagner Bro. · CHICAGO Udylite Corp. Geo. A. Stutz Mfg. Co. · LOS ANGELES Noble Chemical Co. · CLEVELAND Udylite Corp. McGean Chem. Co. · ST. LOUIS LeSalco, Incorporated · TORONTO—CAN. Clark Industrial Supplies Co.

gasoline are involved, in industrial molding such as tubing, and in gasoline and oil lines. Says company: "It can be vulcanized in several ways to acquire high physical properties. It has high tear resistance exceeding that of natural rubber; it can be used alone or blended with other synthetics; it is more resistant to effects of sunlight, ozone, and oxygen than any other synthetic rubber; it has no odor either in raw material state or in finished product; it can be produced with present machinery and is easily to handle during manufacture."—AVIATION, *Jan.*, '44.

Cutter Bodies 7

Meehanite milling cutter bodies which can be fashioned by user to his requirements are offered by **Farrel-Birmingham Co.**, Ansonia, Conn. User simply faces



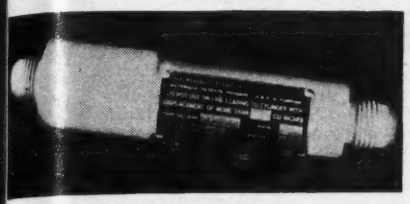
bores, and slots hubs to fit his own equipment, mills tooth seats, and braze on desired tips of carbide or cast alloy. Bottom photo shows body, top cutter finished for use.—AVIATION, *Jan.*, '44.

Magneto Checker 7

For observing contact point action and setting of magnetos, **Joseph Weinenhoff**, Chicago, is marketing testing device known as Model 341 which is provided with gears adjustable to various model magnetos. This gives pattern of lights picturing condition of contact points. Other conditions ascertained are internal timing, primary output, coming-in speed, neutral rotor position, contact point action, and closure and open time. Most tests can be made without dismantling magneto. Special adapters are manufactured for battery ignition distributors.—AVIATION, *Jan.*, '44.

Hydraulic Fuse 80

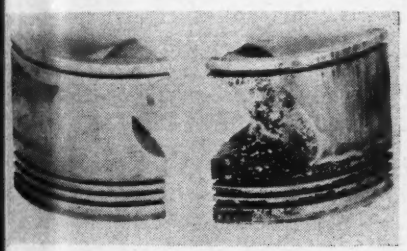
Simmonds Aerocessories, Long Island City, N. Y., announces protective fuse to prevent hydraulic systems from draining away should a section be punctured. While flow rates to 20 gpm. do not affect it, fuse will close, thus containing oil left in system, after a predetermined



amount has passed through it. Capacities range from 10 to 40 cu. in. Air bubbles, surges, and back pressure are reported to have no affect on device's proper operation.—AVIATION, *Jan.*, '44.

Piston Cleaner..... 81

Removal of carbon from pistons without use of heated solutions is called possible by use of new No. 756 cleaner developed by **Magnus Chemical Co.,**



Garwood, N. J. Pistons are immersed in this solution for two hours, then rinsed with water pressure or steam. As photo shows, cleaned part (left portion) is not stained or discolored.—AVIATION, *Jan.*, '44.

Spot Welder 82

Into new portable spot welder for aluminum and light alloys **Sciaky Bros.,** Chicago, have incorporated operating principles of stored energy and variable pressure cycle, both of which have been featured on their other standard type machines. Type PS2R-1 has 100-kw. rating and capacity of from two thicknesses of .016-in. aluminum up to .064 in. and from two thickness of .016 corrosion resisting steels to .080 in. Horizontal water-cooled copper bars mount cables to gun, permitting use of light, flexible cables. Cables, monorail, reactor, and control cabinet are built into one unit which is mounted vertically and pivots on ball bearings through 180 deg. Area reached by gun is thus half circle of 23 ft. dia. Gun transverse movement is 12 ft. and vertical through 40-in. range. Weight of gun is compensated by

Everything Under Control
• • • OF THE "BIG VOICE"
Commands and instructions over loud speakers direct the operations of landing forces and combat units. To operate these, and other communication systems, power is supplied by portable gasoline engine powered generators. One more combat duty added to the many standard and special applications powered by hundreds of thousands of dependable, instant-starting, 4-cycle, air-cooled Briggs & Stratton engines now serving our armed forces.
INQUIRIES are requested from those manufacturers who require portable gasoline engine power for war production — or for their post-war gasoline-powered equipment now being planned.
We are better prepared than ever to carry on the traditions of Briggs & Stratton engines — with the same high standards of quality and precision manufacture, their rugged dependability, easy starting and economical performance — all the features that have earned for Briggs & Stratton the reputation of "the world's finest air-cooled gasoline engines."
"It's powered right — when it's powered by Briggs & Stratton"
BRIGGS & STRATTON CORP.
MILWAUKEE 1, WIS., U. S. A.
BACK THE ATTACK
BUY WAR BONDS
4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES

PANELYTE FLOORING for aircraft, new Martin plastic-aluminum combination, weighs approximately ¼ lb. less per sq. ft. than other floorings. This, and other uses of Panelyte, mean big savings in weight and money for airline operators.

FLUTTER DETECTOR, plus accelerometer and oscillograph, enables Martin engineers to record graphically a plane's flutter characteristics. This development will aid all industry in combating vibration.

LEAK-PROOF FUEL TANKS, America's first, were developed by Martin, are now standard equipment on many makes of U. S. aircraft. Martin experiments on self-sealing fuel tanks date from 1919 in which time 285 materials were tested.

"FIRSTS" for Peace · · "FIRSTS" for War

From Martin Research Laboratories!

ALL-PLASTIC NOSE, giving bombardier full visibility, was first used on Martin Marauders, now used on many U. S. aircraft. Martin plastic research goes back to 1921. Today some Martin planes contain 400 plastic parts.

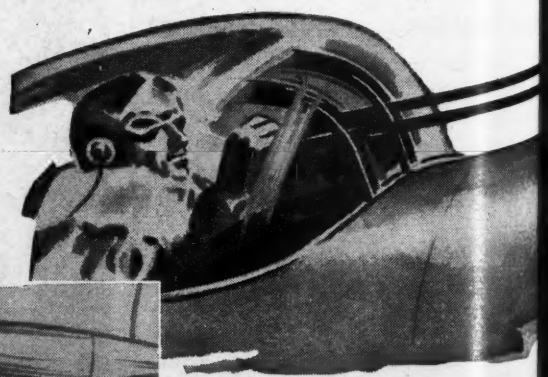
ON this page are pictured just a few of the Martin firsts which help make U. S. aircraft second to none. Other Martin developments are still cloaked in military secrecy, while numerous others, individually minor but collectively important, are in use throughout the aviation industry to give America better planes and more of them. Vital to victory today, these Martin firsts will play outstanding peacetime roles tomorrow, not only in aviation, but in scores of diverse industrial fields. Post-war products of every sort may bear the words "Made by Martin" as a guarantee of excellence.

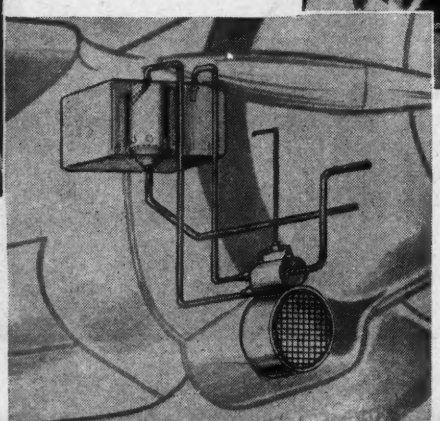
THE GLENN L. MARTIN COMPANY, BALTIMORE, MARYLAND, U. S. A.
THE GLENN L. MARTIN COMPANY—NEBRASKA COMPANY—OMAHA

Martin
AIRCRAFT
Builders of Dependable Aircraft Since 1909

SKIN SHRINKER, ingenious product of Martin engineering, heats the aluminum skin of a plane's wing so that after riveting it cools and shrinks tightly into place without wrinkling or buckling.

NEW DILUENT-LUBRICATION SYSTEM, (below) devised by Martin engineers, provides instant starting in cold weather. After Victory the Martin system will be available for commercial aircraft, trucks, tractors, buses, private automobiles.



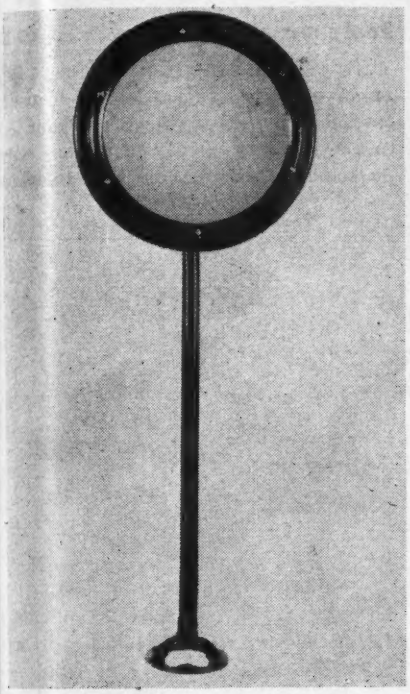


POWER TURRETS like this (above) . . . developed and manufactured by Martin . . are now standard on many types of U. S. aircraft. America's first power-operated gun turret appeared on the Navy's Martin PBM-1 patrol bomber back in 1937.

balancing device, and gun moves 3 ft. 4 in. over monorail. Air operated hydraulic booster delivers pressure up to 1,600 lb. Types with horizontal and vertical guns are available with stationary or buggy mountings.—AVIATION, *Jan.*, '44.

Magnifying Mirror 83

Larrimore Sales Co., St. Louis, is marketing mirror which, when placed 10 to 12 in. from objects such as dials or materials being machined, etc., magnifies operator's vision of them. Silvered plate



glass fits in head with over-all diameter of 7½ in. Flexible 15-in. supporting tube is fastened to base with three holes for screw- or bolt-mounting.—AVIATION, *Jan.*, '44.

Grinder Washer 84

For tightening grinding wheel to spindle, **F & H Mfg. Co.**, Detroit, is marketing spring steel washer which can be tightened down with a wrench, holding wheel firmly. Standard size is 2¼ in. dia. with 1¼ in. hole; other dimensions can be supplied by manufacturer.—AVIATION, *Jan.*, '44.

Boring Tool..... 85

Results of a diamond boring machine are reported obtainable from new boring tool to last many times longer than straight edge cutters. This tool has shearing action which produces a curled chip which slides back over cutting edge resulting in what is described as a re-

Spiraband rapidly removing burrs and rough edges*

Still Time To Benefit

METALITE CLOTH GADGETS (abrasive) have made almost unbelievable records in speeding up and improving the finish of countless metal parts vital to war production.

Yet one division of a large producer may not be aware that another department has doubled or trebled output simply by adopting these skillfully designed, ready-to-use, abrasive cloth "gadgets" of the exact shapes, the very grits and just the right cushion to snug into any odd shaped part.

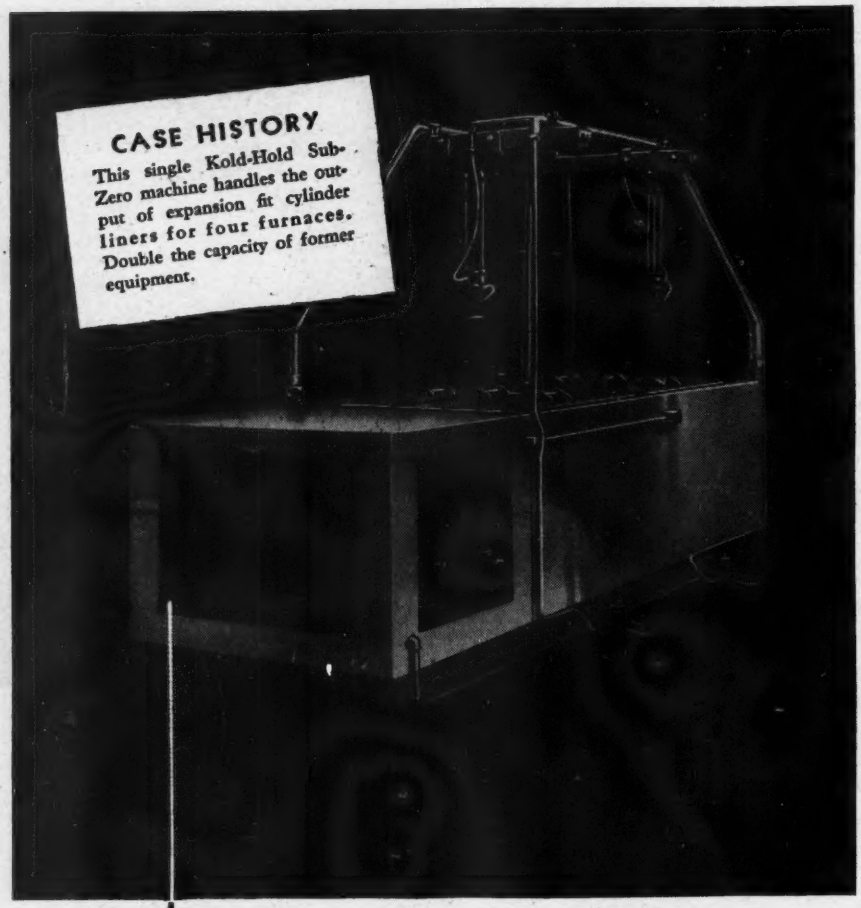
So even now, after two years of war, we urge you to send for our booklet, "Blue Print for Faster, Better Production". It is full of illustrations of these new coated abrasives actually at work in large war plants and shows their host of shapes, sizes and grits ready for instant application on many time-wasting operations in your own plant.

Then, to complete the service, if you just give the word, we'll have an experienced field engineer not only show them to you but *demonstrate them on your own jobs.*

Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Grand Rapids, High Point, Indianapolis, Los Angeles, New York, Philadelphia, San Francisco, St. Louis, Tacoma.

*TRADE MARK

BEHR-MANNING · TROY, N. Y.
(DIVISION OF NORTON COMPANY)
RELIABLE COATED ABRASIVES SINCE 1872


CASE HISTORY
This single Kold-Hold Sub-Zero machine handles the output of expansion fit cylinder liners for four furnaces. Double the capacity of former equipment.

Productioneered

BY KOLD-HOLD

Typical of Kold-Hold "Productioneering for Industry" is this experience of a large automotive and aviation manufacturer (name on request).

Faced with a tough, costly bottleneck, Kold-Hold "productioneered" a cold processing unit to fit the manufacturer's problem . . . the results were — production per hour doubled, serious bottleneck broken, closer fits attained and distortion eliminated. This is an outstanding Kold-Hold "productioneering" performance.

Maybe you have a similar "toughie." A look through our catalog, S-Z 431, may show you a machine that will fit your cold temperature application. Tell us about it and we'll help you "productioneer" your production problem. Kold-Hold machines over a range of from —100° to +200° on capacities from 2 to 400 cubic feet. If pressure and humidity control are required, we have them, too.

KOLD-HOLD

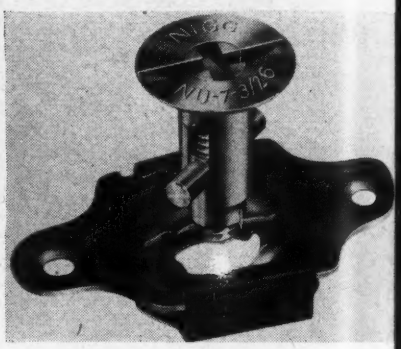
**Engineered for Production*

442 NORTH GRAND AVENUE • LANSING, 4, MICHIGAN

sharpening process. Turning bit in its holder is only operation necessary for replacing cutting edge. Cutting speed to 1,000 ft. min. is reported with mirror finish eliminating need for grinding, filing, reaming, or polishing. Borer is manufactured by **Shearcut Tool Co.**, Reseda, Calif.—AVIATION, *Jan.*, '44.

Fastener 86

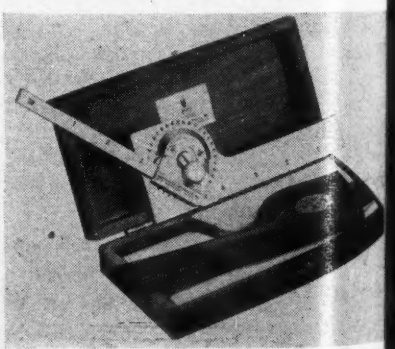
Nigg Engineering Co., Covina, Calif., announces development of self-adjusting fastener for sheet thickness from .025 to .260 in. Central adjusting screw has range of .235 in., and adjustment can



be made to desired tension and torque from the outside. Developed to meet AAF specification AN-F-8, fastener is of standard outside dimensions.—AVIATION, *Jan.*, '44.

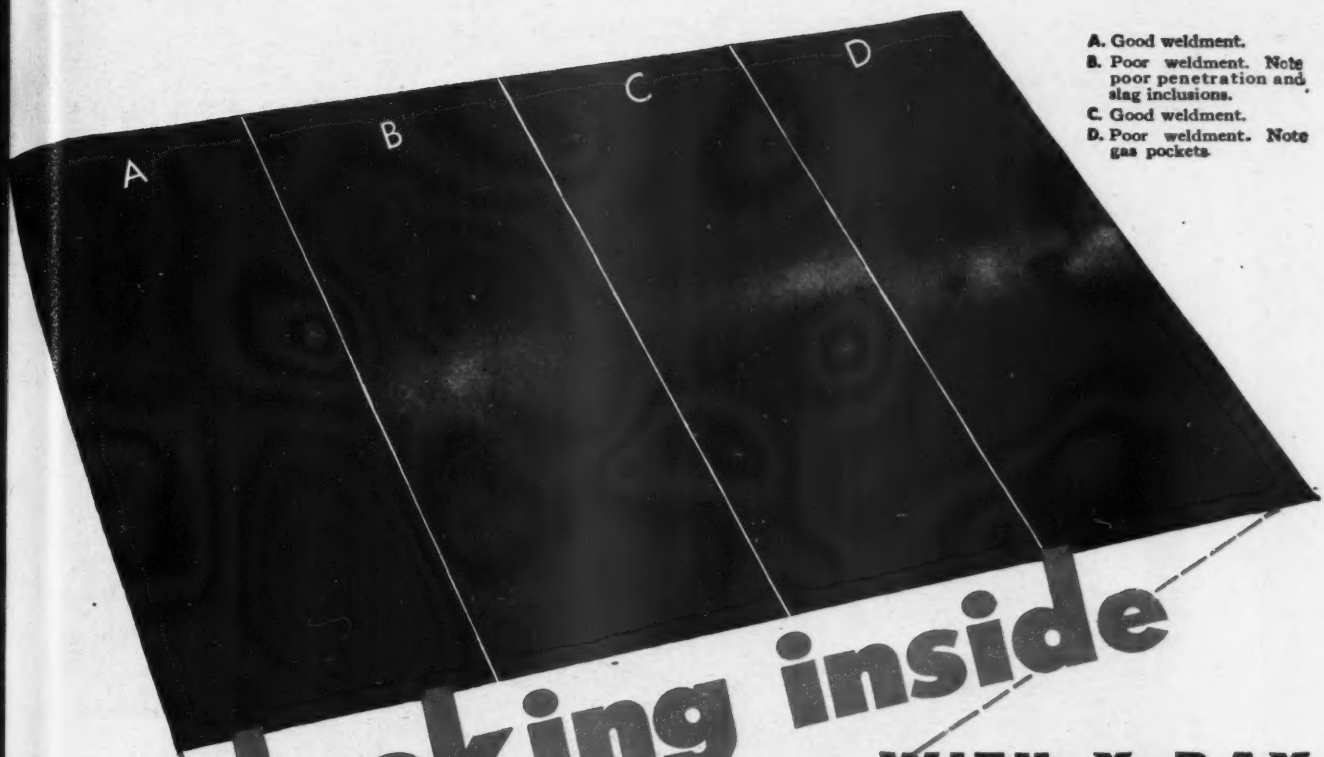
Pocket Protractor 87

Designed for measuring drill points, tool bits, machine ways, deep holes, for sketching and laying out tools and



machine parts, dies, and jigs, and for inspecting finished parts, new pocket-size protractor with sliding scale swings

(*Continued on Page 263*)



A. Good weldment.
B. Poor weldment. Note poor penetration and slag inclusions.
C. Good weldment.
D. Poor weldment. Note gas pockets.

looking inside WITH X-RAY

HELPS TRAINEES "CATCH ON" QUICKER!

They can SEE the difference between a good weld and a bad one

X-ray rules out guesswork in training, qualifying or classifying welders—or other workers—according to actual ability. It puts these all-important functions on a factual basis. For radiographs clarify . . . provide absolute proof . . . are readily understood because they *show* internal conditions that words fail to describe adequately.

They let the worker *look inside* the weldment, casting or assembly . . . show him whether it's good or bad . . . show him what to do and what to avoid. He "catches on" quicker, adheres to good, sound methods, and becomes a faster, more efficient producer from the start.

In addition to shortening training time and putting worker-classification on a factual basis, Westinghouse Industrial X-ray is doing countless other jobs faster, better and more economically. These fall into such major classifications as speeding production, saving machine and man-hours, conserving critical materials and improving quality.

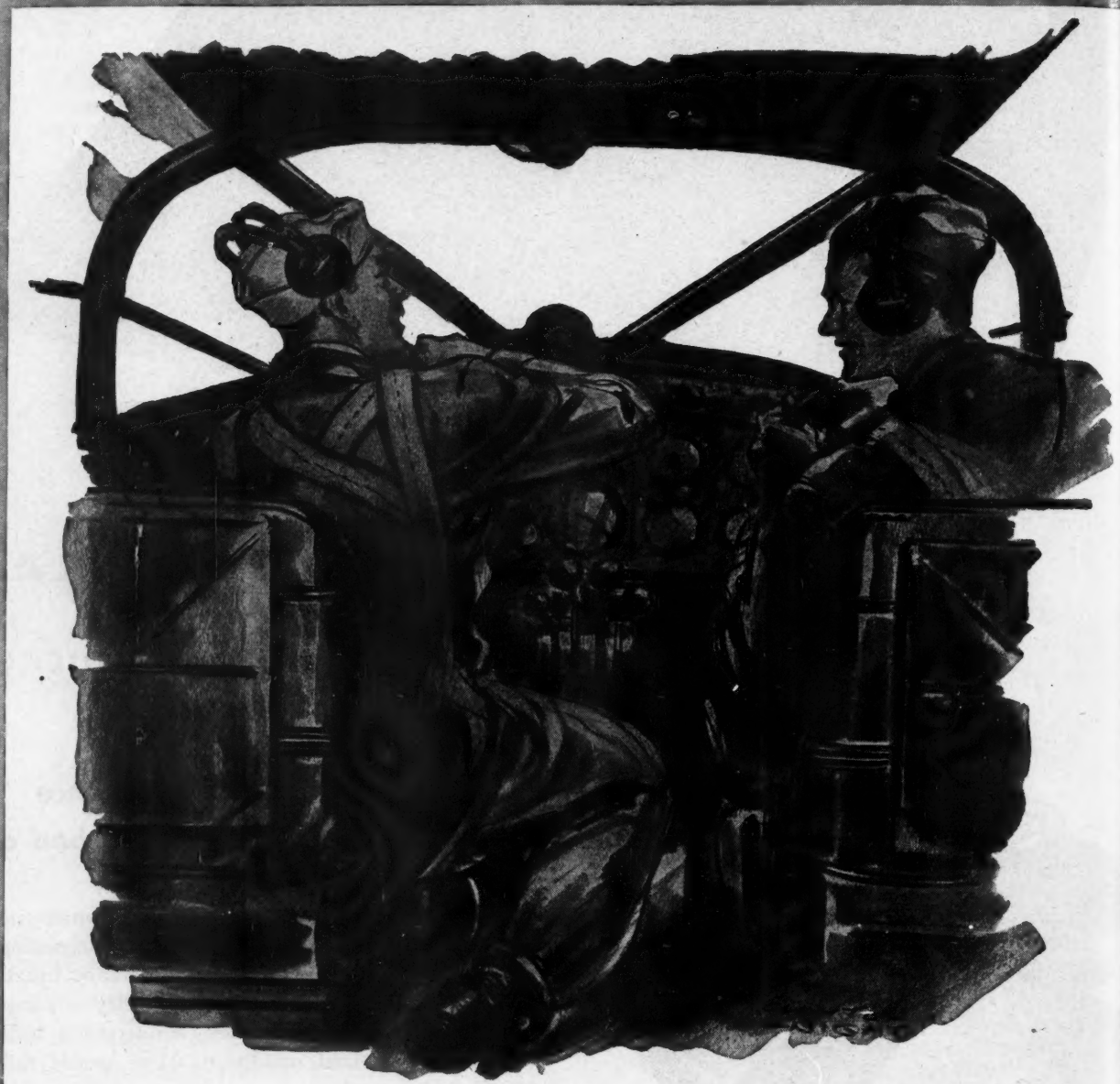
For more information, write for Booklet B-3159. It suggests how and where you can benefit by using industrial x-ray. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N. J-02025

Westinghouse

PLANTS IN 25 CITIES. . OFFICES EVERYWHERE

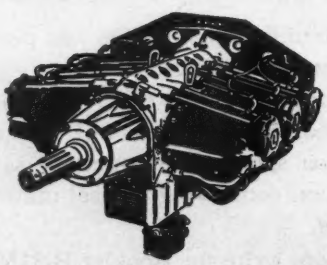
Industrial X-RAY

Makin' the Grade... A LYCOMING FEATURE



"THAT GREAT DAY WHEN YOU MOVE OVER INTO THE FIRST PILOT'S SEAT"

No. 7 of a series sketched from life by Clayton Knight



Lycoming Model GO-435 six cylinder opposed geared engine rated from 210 to 220 horsepower used in primary trainer planes and other special equipment.

MAKERS OF AVCO PRODUCTS

The progress you make is a sure indication of your knowledge and experience. And here at Lycoming, the knowledge and experience behind every Lycoming engine have made these engines known and respected wherever men fly. Their proved dependability is one big reason so many thousands of Lycomings power Army and Navy basic and advanced trainers.

LYCOMING
AIRCRAFT ENGINES

LYCOMING DIVISION——THE AVIATION CORPORATION, WILLIAMSPORT, PA.

scratch one!

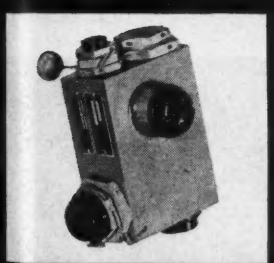
. . . and its job well done, the Hellcat comes to roost on the carrier's deck.

Electrol Hydraulics, precision-built with positive split-second operation, played their part in that "mission accomplished!"

Electrol is proud to wing to victory with the Hellcat and other Army and Navy fighting aircraft.

electrol

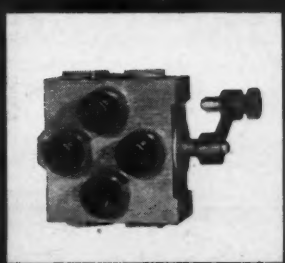
HYDRAULICS



UNLOADING VALVE: Tough and durable, yet astonishingly light and compact, Electrol's Unloader maintains working pressure in hydraulic arteries.

RELIEF VALVE: To guard against unsafe loads. Automatically relieves system at predetermined pressure.

HAND PUMP: In emergencies, the handle of Electrol's Hand Pump snaps to full length for applying pressure to the emergency system.



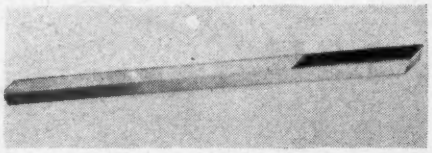
SELECTOR VALVE: Easy installation, light weight, dependable performance. Balanced poppet type results in exceptionally low handle loads.

ELECTROL INCORPORATED, KINGSTON, NEW YORK · HYDRAULIC EQUIPMENT FOR AIRCRAFT

ing 360 deg. is announced by **Industrial Engineering Co.**, Chicago, Ill. Locking feature on vernier turret permits securing of specific measurement, thus permitting mass gaging after initial measurement has been secured.—AVIATION, *Jan.*, '44.

Diamond File 88

Longer lasting and capable of keeping its flat surface, say **Diamond R Agencies**, Pasadena, Calif., new metal-bonded diamond file has 100 concentration. Except for diamond-impregnated portion (right in photo), it can be machined to desired sizes for close work. Furnished measurement is 6x¼x$\frac{5}{16}$ in. Abrasive portion, 1½x¼ in., is im-



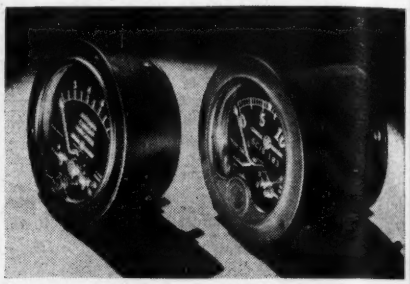
pregnated to depth of .010 in. in choice of three grit sizes, coarse, medium, and fine.—AVIATION, *Jan.*, '44.

Oil Capacitor..... 89

New terminal arrangement is provided on high altitude oil capacitor offered by **Aerovox Corp.**, New Bedford, Mass. One terminal is a short screw post, other a tall insulator post topped by a corona shield. With vegetable oil for impregnant and fill, this design is said to offer effective capacitance at frigid high altitudes. Cover assembly is one-piece ceramic cap. Cap top is spun over rubber gasket.—AVIATION, *Jan.*, '44.

Panel Instruments..... 90

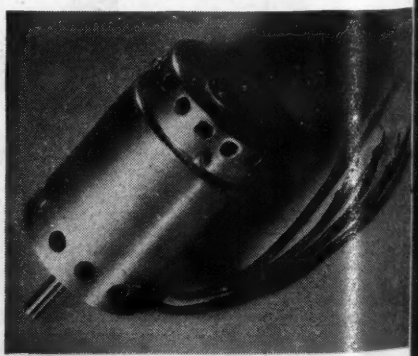
General Electric Co., Schenectady, N. Y., announces new line of direct current panel instruments for measuring volts, amps, micro- and milliamps, and radio frequency amps. One instrument for naval aircraft can measure either



volts or amps through selector switch. Available in either brass or molded Textolite (plastic) cases 2½ in dia., instruments feature new construction in which pivots are solidly mounted on inside of armature. Result is stated to be greater resistance to vibration and shallower case (as shown in left portion of photo) compared with usual construction.—AVIATION, *Jan.*, '44.

Induction Motor..... 91

Eastern Air Devices, Brooklyn, N. Y., announces small, 400 cycle induction motor suitable for driving small cen-



trifugal blowers and adaptable for control work. Operating on 115 v., motor

TURNER PLAST-O-LOCK

(Patent Applied For)

GAUGE SAYS STOP

on its NOT GO member!

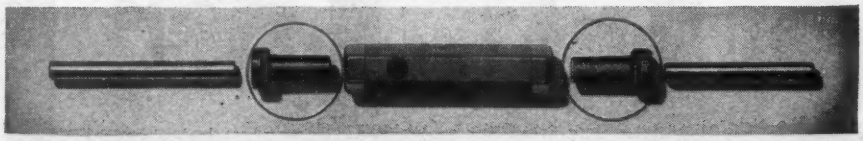
Here's another first by Turner—a *red* plastic collet to more quickly identify the "not go" member of your plug gauges! Plast-O-Lock gauges are great time savers wherever they are used.

Turner's Plast-O-Lock (patent applied for) collet type plug gauges are not only easier to use but they will multiply the life of plug gauges many times. The reason for this is obvious. Because Plast-O-Lock features a collet of plastic, slotted and tapered to fit into the tapered end of a standard plastic handle, it is possible for the gauges to be held securely without their surfaces being scratched or burred, thereby allowing use of most of the gauge's length. For example, as the "go" and "not go" ends are worn beyond allowed tolerances they are simply cut off, thus leaving an unused end ready for gauging. To illustrate further, if a boring no deeper than ⅛" is being checked, as many as 8 fresh gauging sections may be obtained from one standard length "go" gauge as furnished with Turner's Plast-O-Lock. This obviously eliminates the necessity of salvaging used gauges.

For full particulars about Plast-O-Lock gauges wire or write us today.

★ Features ★

1. Multiplies the life of the plug gage.
2. Collet will not mar a lapped or polished surface.
3. Used with plastic handle the gauge has a more sensitive feel in the hands of an inspector.
4. Is easy to make length adjustment because slot is provided for end wrench.
5. Plast-O-Lock size range from .050 to .690.
6. Red plastic collet for quick identification of "not go" members.



TURNER BROTHERS

DELIVERY Fast delivery can be made on these Plast-O-Lock gauges as well as the following Turner gauges: ring, flush pin, snap and built up.

TURNER GAUGE GRINDING COMPANY

2625 HILTON ROAD • • • • FERNDALE, MICH.

2 11/16 in. long and 1 1/8 in. dia. and delivers up to 1-30 hp. at 7,200 rpm. Another type can be wound to deliver up to .1 hp. over short duty cycle. It is same size and weighs 15 oz.—AVIATION, *Jan.*, '44.

Safe Fasteners 92

Reported approved by National Safety Council, new design skin fastener has two improvements for increasing worker safety. Addition of cap to conventional fastener is to prevent spring and fastening element from slipping back, thus reducing chance of flying parts. Secondly, manufacturer, Prestole Div., **Detroit Harvester Co.**, Toledo, has redesigned its installation gun. Now plunger actuating fastener extends within cup to keep fastener from shooting out should it be placed in gun improperly.—AVIATION, *Jan.*, '44.

Motor Relays 93

Two relays (types 68HX100 and 67-XX100) are announced by **Struthers-Dunn**, Philadelphia, to give positive action with less weight for control of split-series field reversing motors used in landing gears, flaps, trim tabs, bomb bay doors, and hoists. There are no sliding contacts, and parts can be inspected easily. Relays are reported operable in all positions and have withstood salt-spray, vibration, and altitude tests.—AVIATION, *Jan.*, '44.

Clutches 94

Automatic centrifugal clutch consists of a chamber partially filled with oil and fitted with rotating hub. Inside are a series of movable wedge-shaped fly weights. As hub starts to revolve, weights fly out into engaged position, as it slows they relax, loosening connection. Clutch, which can be supplied by **Amalgamated Engineering & Research Corp.**, Chicago, in capacities of ¼ to 500 hp. for all types of shafts and transmissions, works in either direction. It can be adjusted to engage and release at given speeds and to slip under overloads.—AVIATION, *Jan.*, '44.

Attachable Tractor Crane...94a

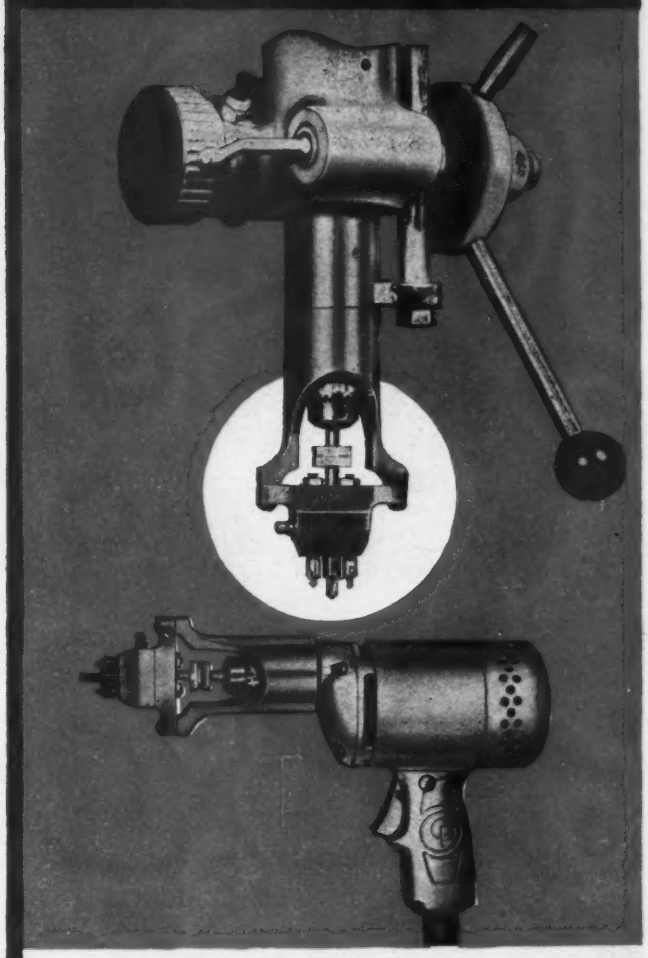
This handy crane assembly is attached to tractor frame by four brackets, two on bumper and two on top of engine hood. Removal of four securing pins attaches crane and clears tractor for other uses. Unit is used at Chicago and Southern for handling training planes engines, which the Army sends in large numbers for overhaul.

(*Turn to page* 273)

FOR FASTER

Nutplate Drilling

Use This Nutplate Drill Fixture



Adaptors available for mounting on drill press or portable drill

Universal joint corrects alignment

Bronze body
Heat treated gears

Stationary pilot may be used when center hole is predrilled

Easy to use by men or women

Test it out in your plant

Send for Nutplate Bulletin

Locates and Drills 3 Holes
Countersinks 2 Holes
} **At One Time**

Fast, accurate and tough . . . this Zephyr Tool is being used to speed production and conserve manpower in aircraft plants in every part of the country. Features include: bronze body and gear case; hardened gears; accurately spaced drill centers; removable cutters, drills and pilots; cutters adjustable for depth; all parts precision made and interchangeable. Send for a few units to test in your plant. Two sizes—No. ZT23 for 6-32, 8-32 and 10-32 nutplates; No. ZT24 for ¼" and larger nutplates.

Write, on your letterhead, for our catalog.

ZEPHYR

High Quality Precision Tools

ZEPHYR MANUFACTURING COMPANY
Factory and Head Office:
201 Hindry Avenue, Inglewood, California
Write for address of nearest branch office or dealer representative.

SCHATZ
AIRCRAFT BALL BEARINGS
PROVIDE
DEPENDABLE, RELIABLE
CONTROL

•

ON EVERY FIGHTING FRONT THESE
PRECISION BALL BEARINGS ARE
DOING AN OUTSTANDING JOB FOR
THE AIR FORCES
OF
THE UNITED STATES

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AIRCRAFT
BALL BEARINGS

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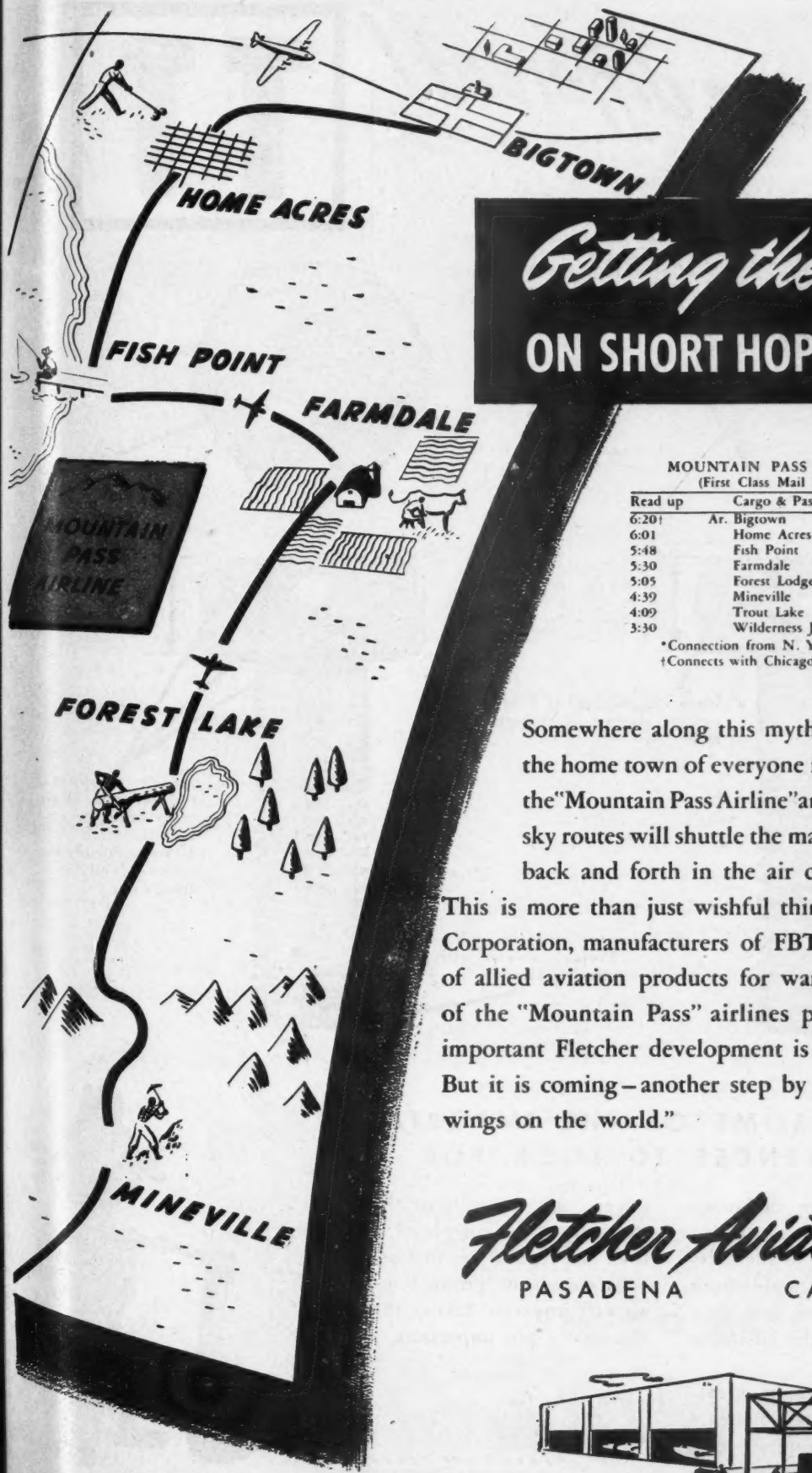


Getting the Jump
ON SHORT HOP BUSINESS

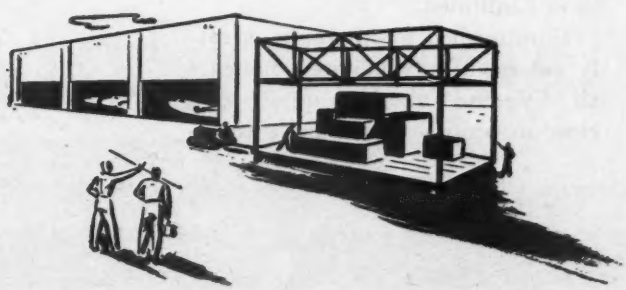
MOUNTAIN PASS AIRLINE
(First Class Mail Route)

Read up	Cargo & Pass.	Read down
6:20†	Ar. Bigtown	Lv. 7:20*
6:01	Home Acres	7:39
5:48	Fish Point	7:52
5:30	Farmdale	8:10
5:05	Forest Lodge	8:35
4:39	Mineville	9:01
4:09	Trout Lake	9:31
3:30	Wilderness Jc.	10:10

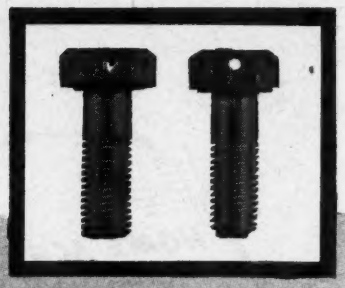
*Connection from N. Y. flight 107.
†Connects with Chicago flight 49.

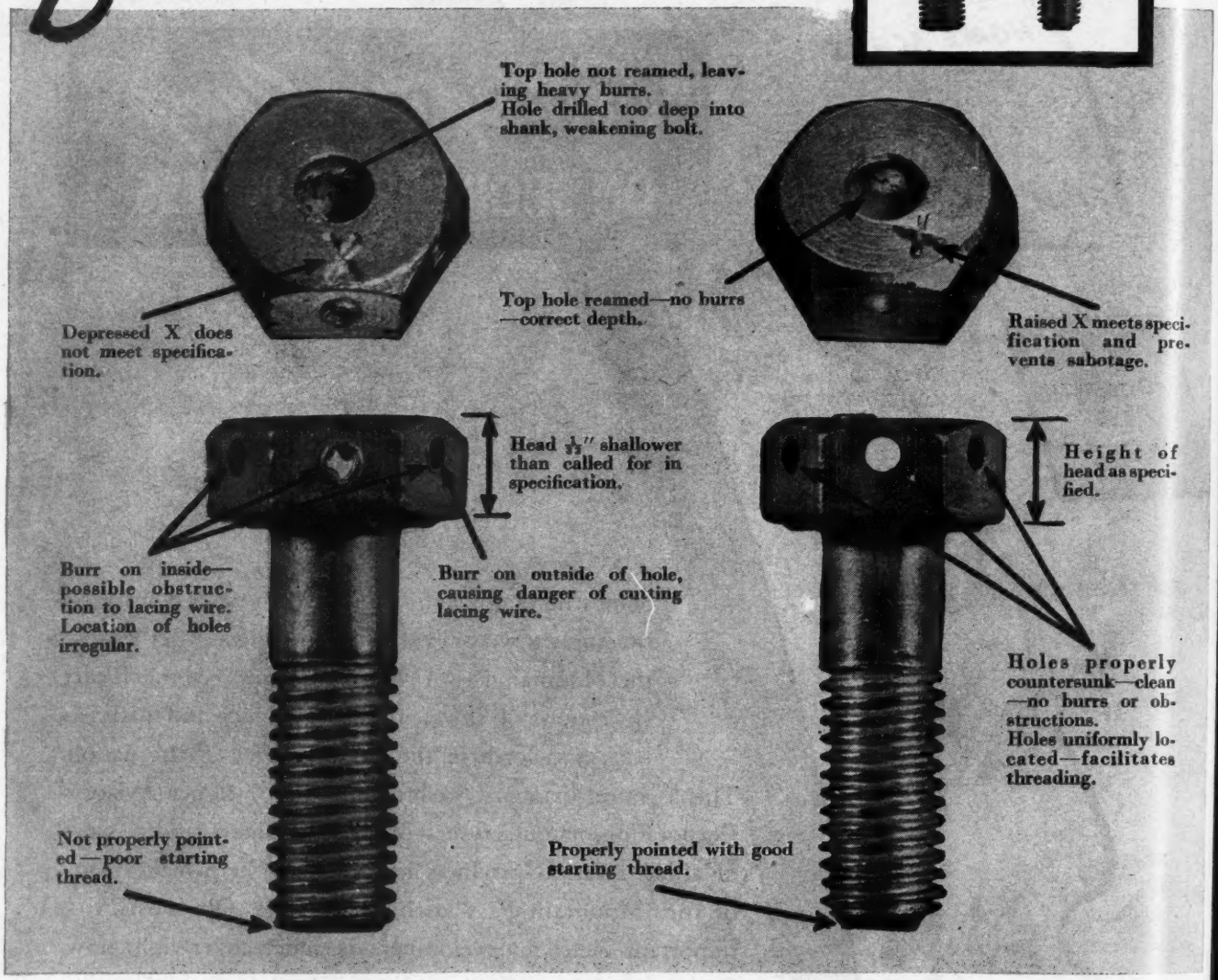
Somewhere along this mythical, short hop airline is the home town of everyone in America. After Victory the "Mountain Pass Airline" and a hundred other feeder sky routes will shuttle the mail and men and materials back and forth in the air commerce of the nation. This is more than just wishful thinking. Fletcher Aviation Corporation, manufacturers of FBT2 Trainers, and a score of allied aviation products for war, will help make many of the "Mountain Pass" airlines possible. Obviously this important Fletcher development is under cover right now. But it is coming—another step by Fletcher that is "putting wings on the world."

Fletcher Aviation Corp.
PASADENA CALIFORNIA



BOLTS are different!




Top hole not reamed, leaving heavy burrs.
Hole drilled too deep into shank, weakening bolt.
Depressed X does not meet specification.
Top hole reamed—no burrs—correct depth.
Raised X meets specification and prevents sabotage.
Head 1/32" shallower than called for in specification.
Height of head as specified.
Burr on inside—possible obstruction to lacing wire. Location of holes irregular.
Burr on outside of hole, causing danger of cutting lacing wire.
Holes properly countersunk—clean—no burrs or obstructions.
Holes uniformly located—facilitates threading.
Not properly pointed—poor starting thread.
Properly pointed with good starting thread.

HERE ARE SOME OF THE IMPORTANT DIFFERENCES TO LOOK FOR

An aircraft company in California wired us to have our representative come and look at some of the bolts they were getting—presumably from us. We looked at them, but they weren't our bolts, as the customer soon confirmed.

Unretouched photographs, greatly enlarged, only partially indicate the differences that are apparent on close inspection of the bolts themselves—one taken from the batch that caused the complaint, and one from *our* regular production.

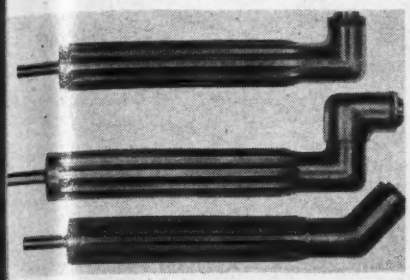
Any engineer, production man or aircraft inspector knows that these differences are important.

National
HEADED AND THREADED
PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

Angle Drills **95**

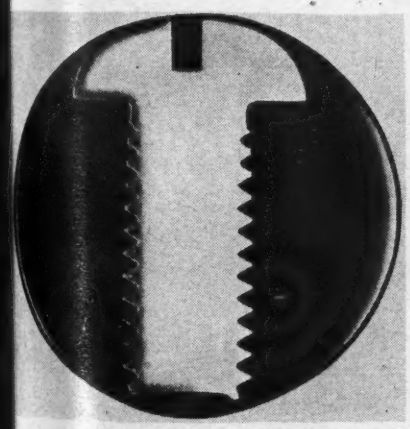
Three additions to its line of angle drills are announced by **Zephyr Mfg. Co.**, Inglewood, Calif., include 45, 90, and 360 deg. swivel head drills for close work. New features include a ball bearing radial-thrust spindle mount, oil-less drive shaft bearings, and die cast ribbed



housing. Longitudinal ribs on housing are provided for greater strength and surer grip. Ball bearing spindle-mounts permit capacity load operation without excessive heating. Parts are interchangeable. Standard spindle thread is ¼-28. Spindle offset is $\frac{3}{32}$ in. Center offset on swivel drill, announces the manufacturer, is 1 in. Shown in photo above, from top to bottom, are 90 deg., 360 deg., and 45 deg. models.—AVIATION, *Jan.*, '44.

Carburization Control **96**

Photo shows screw covered with new paint which protects areas intended not to be carburized when other parts and assemblies to which they are attached are immersed in liquid baths. Paint is applied with brush, according to **Park Chemical Co.**, Detroit, and dries



sufficiently for immersion within an hour. Heat of bath burns out vehicle of this paint, leaving its pigment as a metallic coating. Any of this protective coating which remains after the dipping and quenching operations can be removed by the worker with a wire brush. —AVIATION, *Jan.*, '44.

Air liners with parts of AMPCO METAL *fly safely*

You find parts made of Ampco Metal in the airliners that travel the sky-ways on the home front. The same reliable aluminum bronze that helps to safeguard fighters and bombers is also used in these huge liners that carry busy executives safely on important missions.

For Ampco Metal has proved its value wherever a sturdy, shock-resistant, long-wearing bronze is needed. Today more than two thousand companies are regular users of Ampco products.

Design engineers and metallurgists recognize its value in locations subject to wear, impact, and stress.

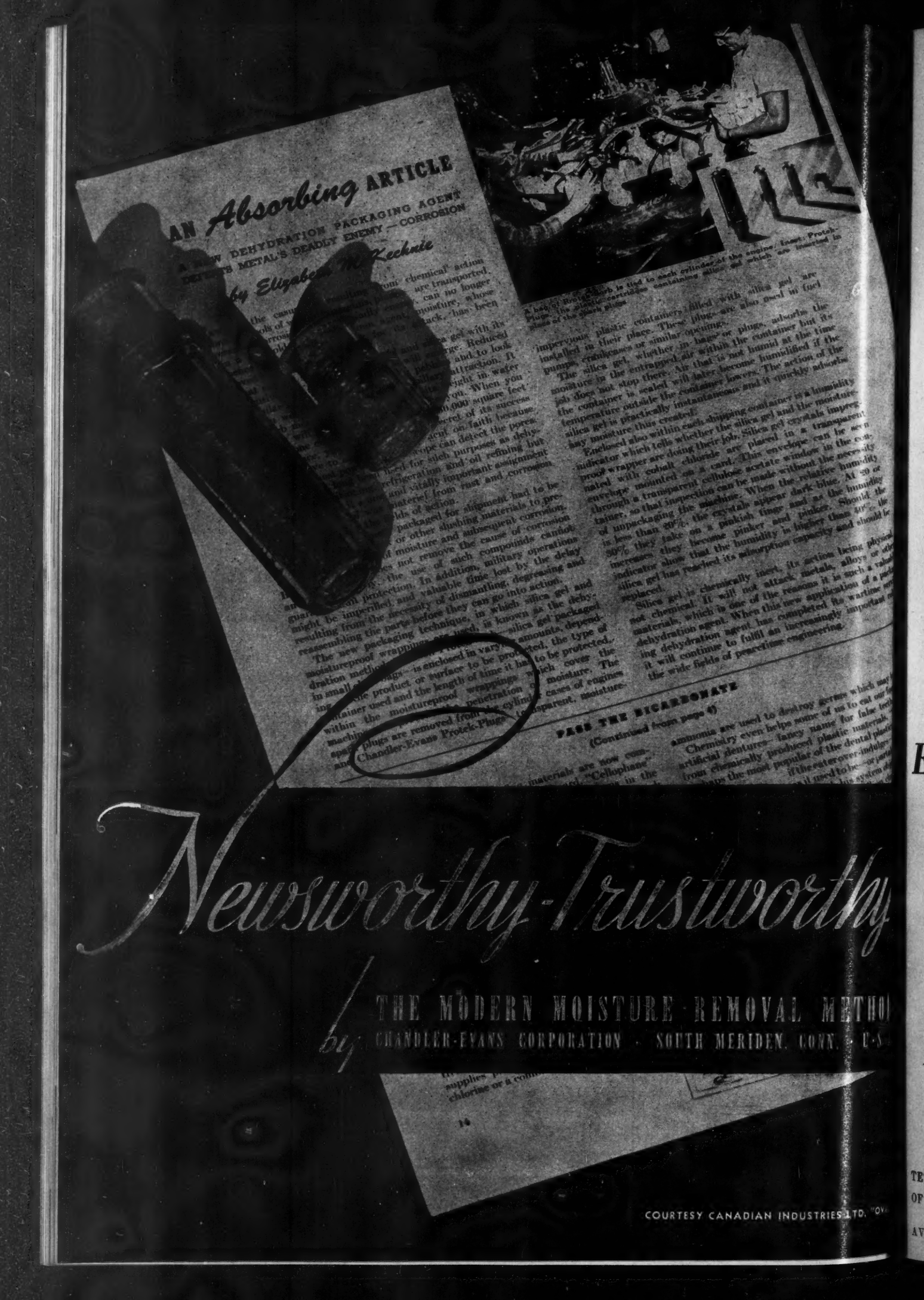
In present and post-war planning, consider the use of this war-proved bronze. Build it into your new equipment for creditable results. Our engineering division will gladly work with you without obligation. Ask for "File 41 —Engineering Data Sheets," sent free on request.

AMPCO METAL, INC.

DEPARTMENT A-1 MILWAUKEE 4, WISCONSIN

AMPCO METAL

THE METAL WITHOUT AN EQUAL


AN Absorbing ARTICLE
A NEW DEHYDRATION PACKAGING AGENT
DEFEATS METAL'S DEADLY ENEMY—CORROSION
PASS THE BICARBONATE
(Continued from page 4)
Newsworthy-Trustworthy
by THE MODERN MOISTURE-REMOVAL METHOD
CHANDLER-EVANS CORPORATION · SOUTH MERIDEN, CONN. · U.S.A.
COURTESY CANADIAN INDUSTRIES LTD. "OV

ELECTRIC MOTORS FOR TURRET OPERATION

Several specially designed Air Associates motors are operating gun turrets in many types of United Nations warplanes . . . The model shown, which operates the hydraulic pump for one of the standard service turrets, provides 1½ hp. continuous duty with intermittent loads of 2½ hp. It is designed with a special spiral bevel gear reduction to give right-angle pump mounting and conserve space; has full ball bearing construction in both motor and gear box . . . *Electric motors for turret operation are but one of the many types of reliable, lightweight motors that Air Associates designs, engineers and manufactures to meet the varied needs of the aircraft industry*... Inquiries invited.

AIR ASSOCIATES, INC.

TETERBORO, N. J. . . . *BRANCHES:* CHICAGO, DALLAS, LOS ANGELES . . . ENGINEERS & MANUFACTURERS OF AIRCRAFT SPECIALTIES . . . SUPPLIERS OF ALL TYPES OF MATERIALS TO THE INDUSTRY SINCE 1927

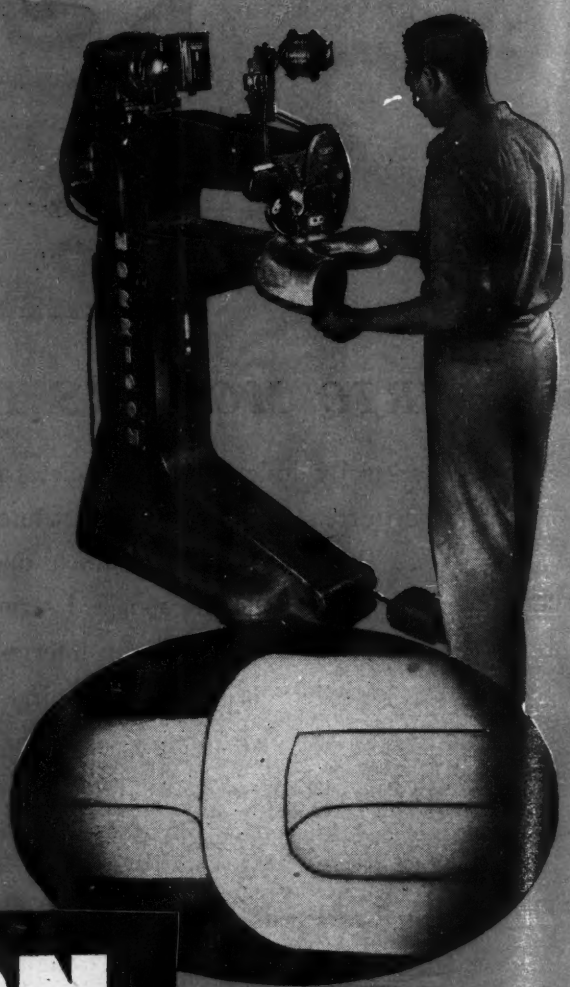
MORRISON

WIRE STITCHING

Approved for secondary structures and non-structural assembly by U. S. Government

FOR THE FACTS

This fabrication method has been thoroughly tested by one of America's leading aircraft laboratories and an official report prepared. For information, write for Bulletin No. 5.



Actual photograph, magnified ten times, of cross section of stitch driven through two sheets of 24ST .040 Aluminum.

MORRISON

PRODUCTS OF THE SEYBOLD DIVISION
HARRIS-SEYBOLD-POTTER COMPANY
DAYTON F7, OHIO

STITCHERS

Reconversion *and* Contract Termination

AMERICAN industry is dedicated to an all-out effort to achieve victory, and its good faith in this direction is amply demonstrated by the results.

American industry also is dedicated to making democracy work effectively after the victory. And it is toward this objective that industry must prepare itself to guide the processes of demobilization and reconversion in order to minimize the dislocations and chaos which too easily can result from so tremendous a task.

We exercised foresight from the very beginning of the war mobilization program. Let us now exercise foresight in the approaching changeover from a wartime to a peacetime economy.

The first step in converting American industry from military to civilian production is the termination of contracts between the government procurement agencies and the producers. There are now in force war contracts amounting to tens upon tens of billions of dollars. As the demand for weapons of war decreases, the Armed Services will undertake to cancel contracts. With the emphasis shifting from weapons of one category to weapons of another category, many billion dollars worth of contracts already have been terminated. It is hoped that the experience now being gained in this work will provide the basis for effective and sound procedures when an avalanche of cancellations comes later.

Many complex problems involved in the termination of contracts will materially influence the success of the entire reconversion program. Once war demands fall off sufficiently to permit the renewal of civilian production, we will have to act with great speed if we are to avoid large-scale unemployment. Prompt financial settlements of contracts and the rapid clearance of plants are of immediate and great significance. In many cases the removal of equipment and raw materials will be more important than money payments. The allocation of raw material for civilian production will be of paramount importance.

Government agencies obviously must exercise great care in spending the people's money and in protecting the interest of the public against excessive payments. Unjust enrichment at the expense of the people will not be condoned nor will it reflect favorably upon management to present inflated claims. But long-delayed negotiations, which will retard the initiation of civilian production, likewise must be avoided.

The contracting agencies and the manufacturers both know that the greatest losses in the reconversion period will result from delays in getting peacetime production under way. The

greatest potential wastes lie in unemployment and in idle plants. The magnitude of such losses to the public can be far greater than the money spent in liberal settlements; to the manufacturer, these losses can represent vastly more than the extra funds that might result from interminable litigation. Policies must be firmly established ***now*** whereby the manufacturers, including subcontractors and suppliers, will receive substantial settlements immediately in order that ample funds be available for reconverting plants and accumulating necessary inventories of peacetime goods. Nor must we overlook the fact that the uncertainty of long drawn-out disputes will have a stifling effect on enterprise and that final settlements, therefore, should be made as promptly as possible.

Plants that are equipped largely with special wartime tools and machines and that are fully stocked with materials, components, and finished military products will not be able to undertake any substantial degree of conversion until this machinery and this inventory are removed. Advance arrangements are essential for the prompt clearance of great numbers of plants the country over. Adequate warehousing facilities must readily be available so that the changeover to civilian production will not be hampered.

As war demands decline, civilian output will be resumed; and while we recognize that the demands for munitions must vary as the strategy of the military leaders is changed, it is hoped that the Armed Services already have or soon will develop schedules of their continued needs under different strategic assumptions. If we know in advance the probable curtailment in war requirements we are in position to estimate the timing and the quantities of raw materials, the number of workers, and the industrial facilities which will be available for peacetime purposes. It will then be possible to integrate the lifting of restrictions on civilian production with the drop in war production.

Needless unemployment and idle plants will prevail if restrictions on the output of civilian goods are removed at a slower rate than available manpower, materials and plants permit. On the other hand, if the controls on civilian production are removed prematurely or too freely, then the production of military requirements will be hampered correspondingly. There will be great clamor and pressure for eliminating all restrictions as soon as any measurable quantity of materials and numbers of workers are freed from war work. It will react adversely on industry as well as on government if these pressures are heeded indiscriminately, thereby retarding the production of munitions for our boys who still will be fighting and dying at the front. The coordination of declining war demands with increasing civilian production probably is the most difficult and at the same time the most important task in our entire reconversion problem. Advance planning and sound judgment are essential.

An order of priority for initiating non-war or civilian production must be prepared beforehand. The schedule of resumption of peacetime production should be governed by the amounts of

materials, manpower and facilities that are available as well as by the relative needs or importance of different products. There will be strong competition for priority among the various kinds of consumer goods, equipment needed for reconversion, producers goods required for expansion and modernization, and export demands. Relative need obviously is the most compelling criterion. But because of the importance of expediting reconversion, earliest consideration is urged for the tools and fixtures and models which will expedite large-scale civilian production when adequate labor and materials are available. In any case, advance schedules will be needed to avoid a makeshift, piecemeal lifting of controls on the basis of who shouts the loudest.

Another difficult problem of the reconversion period will be to keep to a minimum the distortion of inter-industrial and intra-industrial relationships. Many varieties of consumers goods compete for the consumer dollar, and some industries will offer strong resistance if the green light is given first to industries whose products may thereby acquire a time advantage.

Even more difficult will be the matter of competition between companies producing the same products. Some manufacturers may find themselves tied up with continuing war contracts with restrictions on their peacetime products suddenly lifted and their competitors free to take advantage of the situation. The declining need for different kinds of war materiel will vary greatly, and some producers inevitably will be available for peacetime production considerably in advance of some of their competitors.

This raises the question of victory models or nucleus plants to eliminate competitive advantages among producers of identical products pending the time when all are on an equal footing again. Policies controlling this should take into account the degree or the extent of competitive advantage which reconversion might bring, and also upon the time interval during which these advantages will prevail. Such programs necessarily mean increased government control, hence they should be adopted only under the most pressing circumstances.

There is the important question of termination as between large and small plants. Fairness must be exercised, and undue advantage to either group must be avoided in extending opportunities to continue receiving profitable war orders or in getting back into civilian production. The problems of small manufacturers must not be neglected in this period. Likewise, any restraints on new ventures and on more vigorous competition must meticulously be avoided.

There also is the question of communities which have been greatly enlarged and others which actually have been brought into being by the war. It might be advisable to terminate contracts in these areas first in order that the workers might be encouraged to migrate elsewhere while employment prospects are most favorable. Also, if continued production of some armaments is contemplated after the war, it might be well to concentrate this production in communities which otherwise would be stranded.

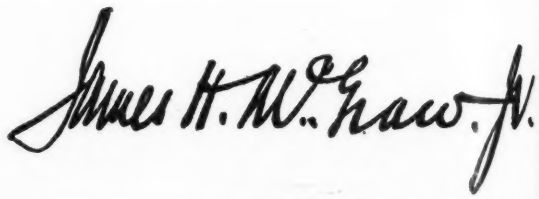
If the process of terminating contracts is to be geared into meeting continued demands for munitions and also expediting reconversion, then the Armed Services must accept broad policy considerations as criteria for cancelling contracts. Procurement officers might be inclined to cancel contracts with all high cost producers first. Or they might be inclined to cancel small producers first so as to reduce the administrative burden. Then again, they might cancel the newer producers of specific products rather than the older, time-tried manufacturers.

These procurement criteria may all be highly desirable and efficient but other important considerations such as those mentioned above must be given proper attention. ***Demobilization cannot be a separate process from reconversion.*** They must be united. The termination of contracts is a demobilization task, but I am confident that the procurement agencies appreciate the importance of this operation in facilitating reconversion and that they will take full cognizance of the policies necessary for giving every assistance to initiating peacetime production.

I have not attempted to raise all the important policy questions in terminating contracts, nor do I propose specific solutions for each major problem. Rather it has been my purpose to indicate the complexities of the task which faces us and to urge that intelligent and sound plans be developed now while there is time. By so doing, we can avoid the dislocations and economic disorder which otherwise might characterize the reconversion period. The better we are prepared, the more rapid will be the resumption of full employment and good business after the war is won.

This job of changing America's industrial pattern from war to peace speedily and efficiently, is one which will tax the talents and knowledge of the ablest business men of the country. These men can, and I am sure that they will, attack this task with the same energy and determination that characterized their efforts in the period of mobilization for war.

Industry advisory committees were established to cooperate with governmental agencies in the great task of conversion to a full war economy. These committees are the means through which industry has the opportunity to play a major role in the solution of the problems of reconversion. It must assume that responsibility or accept the consequences in the form of enforced government control. Industry must take a renewed interest in these committees and make certain that our best minds and strongest men are available for the challenging job of conversion which we face now. It is a job that must be done well if we are to have a good start on the road to a greater democratic and free enterprise nation



President, McGraw-Hill Publishing Company, Inc.

THE HEAVY BOMBERS—mostly four engine jobs—were returning to their home base late one night after a raid over Germany. As they started circling the port, the loud speaker in operations suddenly blasted out: "Hello, Control. Hello, Control. This is F for Freddie. I have only three engines, may I come in please?" Immediately the order went out to "Stand clear," plus the message: "F for Freddie, all clear, come in immediately." No sooner had the big craft with three engines functioning, made its landing, when over the loudspeaker came another urgent voice saying: "Hello, Control. This is M for Mary, this is M for Mary. May I come in now, please. I have but two engines." Urgently Control ordered the "all clear" and said, "By all means, M for Mary come in immediately."

And down came a B-25.

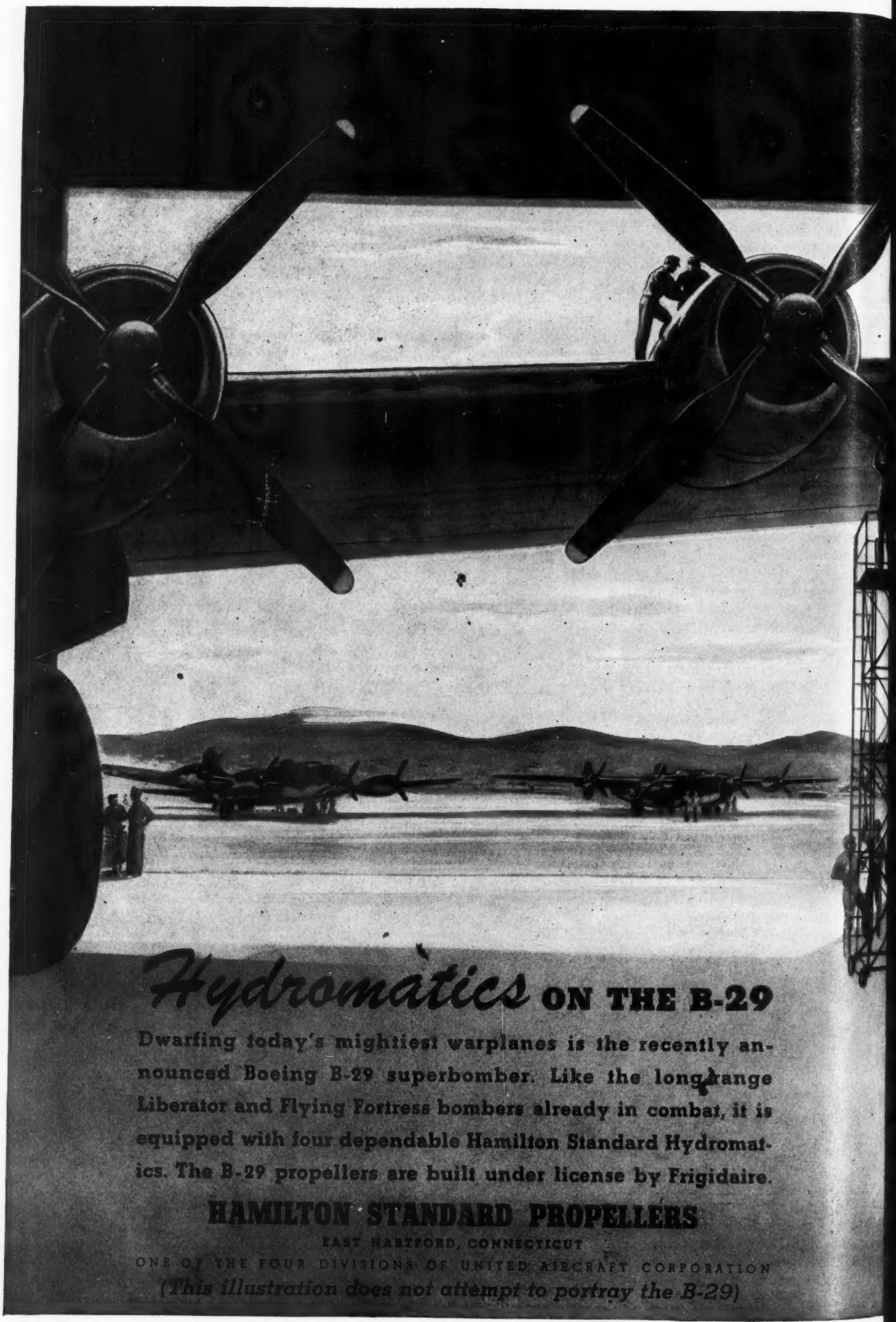
• Some Nazi fighter pilots apparently have radios good enough to bring in American broadcasts. One night one of these Jerries got in with a bunch of returning English bombers and, managing to sneak his plane by all the detection devices, he stayed close to the formation until after the landing flares went on—when he promptly roared down and, to put it mildly, shot hell out of the control tower. He didn't, however, knock out either the radio equipment or the operator, who immediately demanded to know "who in blazes are you?" Instantly a reply came out of the ether, a slightly guttural voice which said, "That, my friend is the $64 question."

• The nadir in helicopter publicity seems to have been reached in the announcement by a New York night club that it has applied to the CAB to operate a roof-top depot for its postwar patrons. A lavish prospectus, with typical starry-eyed illustrations, accompanies the announcement, which includes a set of what are undoubtedly tongue-in-cheek rules for both patrons and chorus girls. . . . All this while legitimate publications, trying to be of some service to their country, are ordered to curtail their use of paper.

• Got quite a lift from a recent talk with a prominent machine tool builder. He simply refused to be as gloomy as a man is supposed to be who theoretically has helped sell himself out of a market for the next 10 to 15 yr.—which his industry has done with its magnificent job during the last three annums. His point is this: Come the peace, labor costs are not going to drop precipitously, so manufacturers are going to have to make savings in other fields. That mean's they'll need more multiple-operation machines for doing a lot of things skilled operators now have to do. And that means a lot of new design thinking in the industry as well as straight building to replace those tools now fast wearing out. He's doing everything he can to promote such thinking among his competitors and is confident enough of the results that he isn't planning on his own organization even returning to single-shift operations. "We've got a lot of good employees here and we'd like to keep them on the payrolls," he says.

• The rules covering what can and cannot be said by aircraft producers are, to say the least, most confusing. Companies which consistently meet their schedules wouldn't dare give the slightest hint as to the actual numbers involved. Yet a great automobile manufacturer who was—long, *long* ago—going to build 24 bombers a day (that would be 8,760 a year) is permitted to report that during the last year "more than 1,000" had been flown from the plant. And a publicity-wise shipbuilder, who recently took over a plant, announced the exact number of fighters delivered during a specified time. The organization was actually congratulated by no less than an admiral for meeting *66 percent of its schedule.* It would seem that publishing figures of some really good production records would give a lot less "aid and comfort to the enemy" than permitting such announcements which only serve as "good publicity" for the firms involved.

"Maguire's rheumatism has made him take up gliding."



Hydromatics ON THE B-29

Dwarfing today's mightiest warplanes is the recently announced Boeing B-29 superbomber. Like the long-range Liberator and Flying Fortress bombers already in combat, it is equipped with four dependable Hamilton Standard Hydromatics. The B-29 propellers are built under license by Frigidaire.

HAMILTON STANDARD PROPELLERS

EAST HARTFORD, CONNECTICUT

ONE OF THE FOUR DIVISIONS OF UNITED AIRCRAFT CORPORATION

(This illustration does not attempt to portray the B-29)

The AVIATION NEWS

BLAINE STUBBLEFIELD, Washington HERB POWELL, New York

Lea Bill Stirs Up "Aye" and "Nay" Battle Over Question of Extending Federal Air Control

Regarding the Lea Bill (HR 3420), a definite division of proponents and opponents had lined up, as we went to press. In favor of it are big airline operators and manufacturers. Against it are regulatory bodies of at least 31 states and certain manufacturers and distributors of personal planes.

On the sidelines are the railroads and other surface carriers. However, the latter see in its defeat possible passage of a substitute permitting them to enter air commerce.

HR 3420 (as digested by a member of the Supreme Court bar) provides among other things: An independent Civil Aeronautics Commission. . . . Independent accident investigation by a director of air safety appointed by the President with Senate confirmation. . . . An extension of federal jurisdiction. . . . Development of navigation facilities and airports. . . . Studies on postwar aviation potential, on flying of all classes of mail where air service is faster, and on multiple taxation.

Local opposition is perhaps best expressed in a resolution, adopted by the Illinois Aeronautics Commission, which says that the bill contains "unconstitutional deprivation of the inherent sovereign powers of the several states to regulate intrastate commerce without let or hindrance from congress." Other opponents point out the encumbrance laid upon chartering by the fixed base operator by the passage "No person shall engage in any air commerce as an air contractor unless there is in force a license issued by the commission authorizing such person to engage in such commerce."

One unofficial interpretation on this passage is that once a fixed-base operator had obtained his license he probably would be free to charter at will at commission-approved mileage rates.

On the federal-state dispute, Lea writes, "The Committee's Bill provides for exclusive federal regulation of point-to-point air transportation for hire, either by a common carrier by air or by a contract carrier. For this purpose the Bill defines the term 'domestic air commerce' to include both interstate and intrastate transportation.

"However, such term does not include other types of civil flying. And State regulation of civil flying other than point-to-point transportation for hire is not excluded by the Bill. All such civil flying—*and this will mean the major part of civil flying*—is left to State regulation subject only to two conditions. One is that State regulation be consistent with the federal safety regulation applicable thereto. The other is that the State regulation shall not burden interstate flying or impair the uniformity of conditions under which an interstate flight is conducted. The civil flying thus under State regulation would include the commercial use of an airplane in one's own business or the private carriage of persons or property other than for hire; the operation of training schools and flying for training purposes; aerial survey work; aerial patrol work; use of aircraft for agricultural purposes.

"The Committee Bill, like the present law, leaves the regulation of airports to local and state authorities."

The Lea Bill likewise leaves unchanged the present prohibition against participation in air commerce by ground and water carriers.

A minority of Lea's House Interstate and Foreign Commerce Committee has reported a bill (HR 3491) written by B. Carroll Reece. In practically direct contrast, it contains no prohibitions against state regulation of interstate flying and allows surface carriers to go into air transport.

Perhaps the strongest point in favor of the Lea Bill from the operator's standpoint is the provision for uniform interstate regulations.

ROSENDAHL HONORED

From Mayor F. H. LaGuardia, Rear Adm. Charles E. Rosendahl receives the Frank Hawks Memorial Trophy of American Legion Air Service Post 501. The Admiral is among the 60 percent of this post's members now on active duty. Said the Mayor: "You have made as great a contribution to aviation as anyone living."

Public Will Have to Wait For Helicopters—Loening

Grover Loening, chairman of NACA's helicopter committee, says direct lift machines will not be available for public use right after the war and that premature promotion is threatening their future development.

Truth is, he says, that the helicopter will be limited to use by professional aviators and organizations for an estimated 5 to 10 yr.

As presently designed, Loening says, the machine's chief handicap is controls, which require greater operating skill than those of present airplanes. Another handicap is limited speed, and the fact that it may take many years to develop a model that will fly much over 200 mph. By that time many commercial planes may be doing 400. Other obstacles are poor performance at high altitudes, vibration, and high cost of construction.

Mr. Loening says the prospects for a combination helicopter-auto are none too promising. But he predicts extensive postwar use of helicopters by companies employing professional pilots—airlines, merchants, mining and oil companies and in lifesaving, law enforcement, and patrol work.

Postwar Products Contest

Underway at the Lincoln Electric Co., Cleveland, is a special postwar planning competition for employees. Intended to gather ideas on suitable Lincoln postwar products and suggested methods for their manufacture, the contest will extend to July 1 and winners will be announced Aug. 1. Prizes of $500, $300, and $100 are offered.

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8th Increases Bomb Tonnage 30% in Month; Russians May Join Air Attack on Germany

Washington (AVIATION Bureau)—Allied air force pressure on the enemy increases day by day. The Japs, broadcasting for home consumption, admit that their outer supply lines have been cut, one after another, by air attack. U. S. 8th Air Force alone sent 1,000 more bombers over Europe in November than in October, carrying 30 percent more explosives, totaling 7,670 tons, including incendiaries.

Gen. Arnold states that in the two years since the Jap attack, 13,500 enemy planes have been destroyed or damaged by his command. American and British air forces shot down 997 Axis planes on all fronts during November, with Allied losses of less than 500, according to the British Air Ministry. It should be noted that these enemy losses are far less than production by the enemy, who is therefore still gaining airpower. But Allies meanwhile are gaining much faster.

Agreements reached at the Moscow and Teheran conferences indicate that air war will be constantly intensified, but there was no hint that surface operations will be curtailed in any way.

Robert A. Lovett, Assistant Secretary of War for Air, wrote for the *Army and Navy Journal* that two "new and superior" Army fighters are in production and soon will join combat.

Navy has increased its air arm objective from 27,000 planes to 31,000. This is not truly definitive, as the Navy takes all the planes it can possibly get regardless of its goal. Value of deliveries in 1944 will exceed 1943 by about $1,500,000,000.

Navy's carrier forces have been doubled in the past eleven months and can be more than doubled in 1944 if necessary. The U.S. has the materials and manpower to build two standard fleet carriers per month; indications are that one or more is being built now.

In a recent communique on an attack by Rear Adm. Charles A. Pownall, it was revealed that a carrier division has at least two carriers, and that a task force has at least two divisions. At least two divisions have been used recently against Jap strongholds.

Gen. MacArthur's Allied air forces have been hitting single Jap bases with more than 100 tons of bombs per day, which is big league action even on European standards.

In Europe, the Allies' bomber commands are using a new strategy. They hit two high priority targets in force at once thus dividing the Nazi's fighters and partially preventing concentration of mobile AA defenses. Allies now have enough planes to put two 1,000-plus forces up at the same time.

British official reports say that 17 major cities of Northwest Germany have been so smashed that they are liabilities rather than assets to the Wehrmacht. Six others have been damaged so that one more 750-1,000-plane assault will put them out of business.

To the present three-way air attack on Germany — from England, the Mediterranean, and the Middle East—may soon be added another from behind the Russian lines. The Nazis fear that such a deal was made at the four-power conferences. With exception of a few missions against Poland and East Prussia, increasing Russian air power has been used in support of the Red Army.

Here at home, portending the future, a troop carrier wing set down a whole Army division by plane and parachute during maneuvers in North Carolina. Ammunition and supplies were brought up with the 10,000 men. The Army used 211 transport planes and 411 gliders.

"Mars" Completes Mission

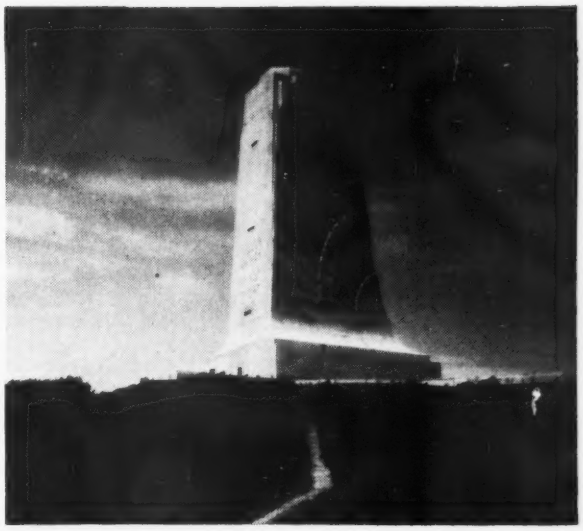
Navy has begun discussions with Glenn L. Martin Co. for more cargo carriers of the *Mars* type, Sec. Knox reveals in announcing that the big plane has completed its first war mission, flying to Brazil, Trinidad, and Bermuda.

Records set by the *Mars* in this operation were a 4,375-mi. non-stop hop from Maryland to Natal, at a record average of 152 mph. and lifting 35,000 lb. of cargo, part of a record gross weight of 148,500 lb. Flying time for the 8,972 mi. was 55 hr. 31 min., an average 161 mph. for total time aloft.

Briton Here for Air Talks

At press time, arrival in this country of Lord Beaverbrook, Lord Privy Seal in the Churchill government named to coordinate postwar aviation problems, pointed to the imminence of British-American discussions regarding an equitable postwar international air policy. Talks, it is understood, were to follow the meeting of the heads of the United Nations governments, and with Teheran now past, this air policy meeting may be expected shortly.

Hail 40th Anniversary of Kitty Hawk



Impressive Wright Brothers Memorial on Kill Devil Hill, Kitty Hawk, N. C.—scene of the pioneers' initial flights on Dec. 17, 1903

FOURTH DECADE of man's conquest of the sky with heavier-than-air machines was widely marked on Dec. 17—the 40th anniversary of the first successful flights by Wilbur and Orville Wright at Kitty Hawk, N. C. Especially noted were the spectacular developments achieved in aviation in the comparatively short span since the pioneering at Kitty Hawk.

Aviation's great war role particularly emphasized the almost unbelievable contrasts between yesterday and today. America's air industry now leads all the country's businesses in dollar values. It has designed and produced thousands upon thousands of high-powered fighters and multi-engined, multi-tonned, long-range aircraft. In this world at war, aviation is termed the single greatest influence on our times. And it is foreseen that this influence will continue, difficult though the hurdles may be, through broadening developments in the coming peace.

In view of aviation's achievements and meanings today, it strains one's perspective to compress, in retrospect, such comprehensive and complex developments back to their beginnings—the 12-hp. 754-lb. craft which Wilbur and Orville Wright took into the air from Kill Devil Hill in 1903. But there is certainly no question of perspective in the true evaluation of the Wright Brothers' achievement. No matter what successes have been won in airplane flight since Dec. 17, 1903, they are rooted in Kitty Hawk.

In Washington last month, Congress resolved "That the Nation express its gratitude and respect for this signal and astounding contribution to the progress of the world."

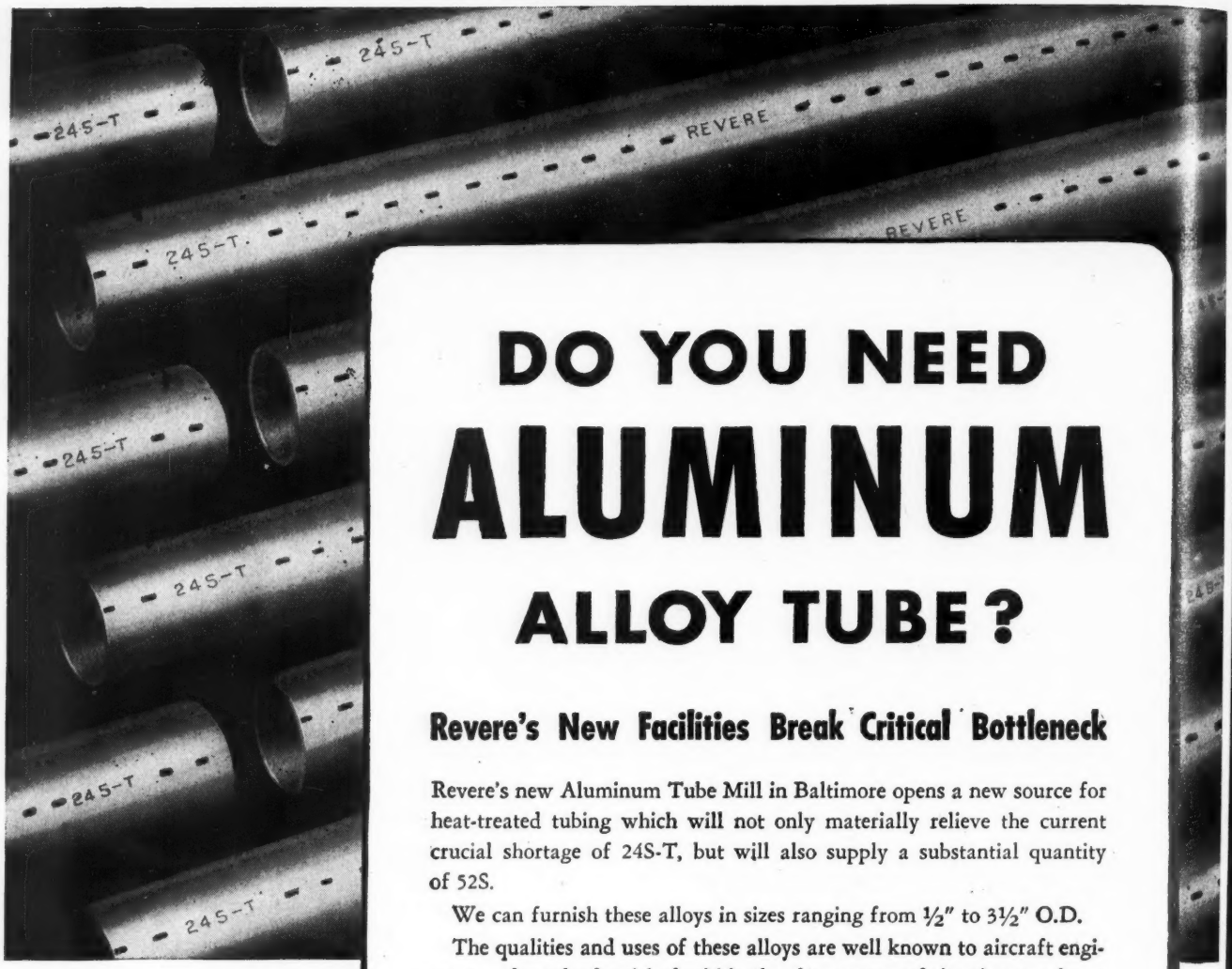
To Washington came 72-yr.-old Orville Wright where he and the memory of his brother were extolled at a dinner organized by Secretary of Commerce Jesse Jones.

Pres. Roosevelt sent a message revealing that the reconstructed original plane, now in possession of the British Museum, will be returned for permanent exhibition by the Smithsonian Institution. To the dinner (where Gen. Arnold received the Collier Trophy) the Army flew a commemorative plaque for presentation to Orville Wright by the City of Dayton.

In Dayton near Wright Brothers' Hill Memorial, adjacent to Wright Field, an observance was held by Army officials and old-timers who had witnessed the Wrights' practice flights in the vicinity.

Earlier that day in Washington, in the U. S. Chamber of Commerce Auditorium W. S. Farren, chief superintendent of the Royal Aircraft Establishment, delivered the Institute of the Aeronautical Sciences' Seventh Wright Brothers Lecture on Research for Aeronautics—Its Planning and Application.

To Kill Devil Hill a few people beat their way through the heaviest snow in 25 yr. for a small ceremony held despite the forced cancellation of North Carolina's official program.



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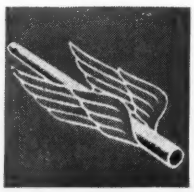

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Methods of Stimulating Postwar Private Flying Are Considered at Mid-Western Conventions

St. Louis (Special to AVIATION)—In an atmosphere reminiscent of prewar aviation exhibits, several hundred delegates gathered here recently at simultaneous conventions of the National Aviation Training Assn. and the Aircraft Distributors & Manufacturers Assn. For the NATA, which includes the nation's fixed base operators and aircraft distributors, it was the fourth annual meeting. ADMA, representing distributors and manufacturers of power plants, parts, accessories, and equipment, was holding its first annual convention following a preliminary meeting in New York.

Although all those present were part of the totally war-converted aviation industry, most were engaged in commercial aviation activity long before the war and expect to return to this phase of the business after victory.

A foretaste of personal plane merchandising and use was evident in the addresses of Robert H. Hinckley, former Assistant Secretary of Commerce for Air, Joseph T. Geuting, Jr., chairman of the Personal Aircraft Committee, Aeronautical Chamber of Commerce, and Leslie E. Neville, editor of AVIATION.

The speakers made it clear that the postwar volume of personal aircraft sales would depend upon the utility of future designs, upon government support of flight training for youth, upon provision for adequate landing facilities under government sponsorship, and upon simplification of both federal and state regulation of personal flying.

Complete elimination of the dare-devil aspects of flying and a shift in emphasis to the safety and reliability of planes were advocated as themes for future aircraft shows. Development of airports as recreation centers resembling medium priced yacht clubs was recommended as were government sponsored training programs for high school students unable to fly at their own expense. Possible postwar conversion of Civil Air Patrol into a nationwide vehicle for the administration of a youth training program similar to the prewar civilian pilot training scheme was also discussed.

Grave concern was apparent at both conventions over the problem of distributing surplus equipment and supplies. An enlightening paper by H. P. Ladds of the National Screw & Mfg. Co. led to a resolution recommending legislation to soften the impact of surpluses and to maintain adequate reserves of these materials and supplies for future defense of the country. The resolution also advised that those responsible for surplus distribution consult with the aviation parts, supplies, and equipment industry.

The proper relationship between manufacturers and distributors was discussed by R. H. Rowland, vice-president of sales, Champion Spark Plug Co., and Thomas G. Tynan, Electric Storage Battery Co.

Other topics considered included: Distributors' facilities and policies, L. W. Trees, Scintilla Magneto Div., Bendix Aviation Corp.; manufacturers' methods to improve distributor-salesmens' knowledge of their products, Dwight P. Joyce, The Glidden Co.; and improvement of data and price sheets for distributors' catalogues, G. B. Van Dusen, Van Dusen Aircraft Supplies.

ADMA afternoon sessions were devoted to service clinics conducted by manufacturers' representatives, including Victor Div., RCA; Eclipse-Pioneer and Scintilla Divs., Bendix; Sensenich Bros.; Hamilton Standard Propellers; United Aircraft Service Corp.; Atlantic Rayon Corp.; The Glidden Co.; Titanine, Inc.; Firestone Aircraft Co.; Goodyear Tire and Rubber; Continental Motors; Lycoming Div., Aviation Corp.; Franklin Div., Aircooled Motors Corp.; Wright Aeronautical; B. G. Corporation; and Champion Spark Plug.

Demonstrations of personal aircraft, including the spin-proof twin-control *Skyfarer* developed by General Aircraft Corp., were conducted. The *Ercoupe*, also a twin-control spin-proof plane, was on view at nearby Parks Air College, where postwar plans are already underway for the development of a middle western sales and service organization. (For further convention details, see p. 239.)

The Washington Windsock

By BLAINE STUBBLEFIELD

Logic dictates that major overseas air services must make New York their terminus—according to New York's Port Authority Chairman Frank C. Ferguson. Cleveland, Chicago, St. Louis, Dallas, Omaha, and Seversky will remind him that airplanes fly right across shore lines.

Hitler admits (in a speech) that 2 or 3 million German homes have been destroyed. Ten or 15 thousand persons are killed in every major Allied mission. RAF-AAF "worker displacement" bombing is the same thing London got, many times multiplied.

Years ago, automobiles stole most passengers from river and coast boats and many from railroads. Personal airplanes may someday take them away from the airlines.

A very few applicants for air routes file documented evidence on traffic, costs, engineering. Most simply file argument, in legal jargon. There will be a big differentiation on the day of judgment.

Enemy railroads are almost impossible to bomb out of service for any great length of time. Even damage by demolition crews on the ground soon is repaired.

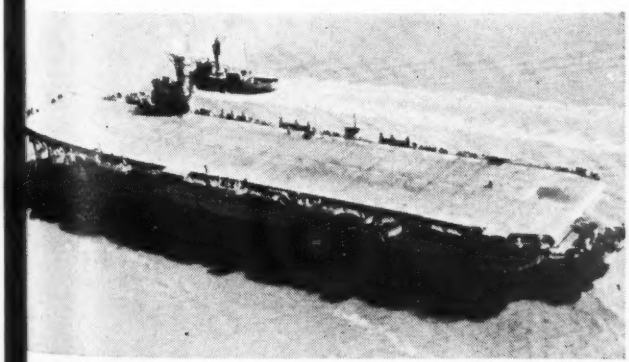
Brig. Gen. Johnson, colonel when he led the Ploesti attack, afterward saw two distillery towers still standing. He went back, turned his ship on its side (because the space wouldn't clear his wings), and passed between them —thus enabling his crewmen, who had no more bombs, to set fire to both towers with their guns.

Inefficient manufacturers will be first out of war business. Sounds like good news to them—because they figure they might beat their betters back to peacetime work. But WPB and the armed services have some ideas on that.

There is plenty of aluminum for all purposes now, but steel has been engineered into some airplanes so well that it can be taken out only with difficulty and loss of time.

The Jap empire, built during 50 yr. of military aggression, is now one of the greatest in history, encompassing 500,000,000 people (about one-fourth of the world total) and 300,000 sq.mi. Chief weakness in this powerful set-up, which will soon lead to its liquidation, is lack of technical imagination.

Production of many weapons will be shut off and manufacturers released for peace work, but aircraft producers may be held fully on the job to the end. Some sort of handicap or compensation system may be necessary to equalize opportunity.



ESCORT CARRIER—FROM ABOVE

One of first air shots indicates layout of escort carrier flight deck and its size compared with that of tug. Control bridge is forward, broad on the starboard beam, instead of amidships, but gun and equipment emplacements are along edges of deck as usual. This one, "U.S.S. Card," her sisters, and accompanying destroyers, have received Presidential unit citation for sinking more subs than any combination in Naval history. (British Combine photo.)

Atlantic Mark by B-24

Another new Montreal-Britain record was chalked up during the past month when a Consolidated B-24 *Liberator* bomber of the RAF Transport Command covered the 3,100-mi. run in 11 hr. 35 min. Previous record was 11 hr. 56 min.

Canadian Notes

By James Montagnes

Royal Canadian Air Force is forming a new transport command to handle trans-Atlantic mail flights to Canadian servicemen in Britain and in the Mediterranean area, according to an announcement from Ottawa by Air Minister Maj. C. G. Power. The new RCAF service will be in addition to existing twice-weekly flights operated by Trans-Canada Air Lines with modified *Lancasters*. RCAF crews are now being trained for the run and planes are expected at an early date.

Immediate creation of a free and independent government authority for civil aviation with wide powers to promote, administrate, and safeguard development of domestic and international air transportation through Canada, was recommended at the recent annual meeting of the Air Industries and Transport Assn. Current problems of the industry — personnel, operations, government policies—were discussed at the two-day session of manufacturers, suppliers, service operators, and transport companies. R. B. C. Noorduyn of Noorduyn Aviation, Ltd., Montreal, was re-elected president of the association with C. H. Dickins, Canadian Pacific Air Lines, Montreal, vice-president.

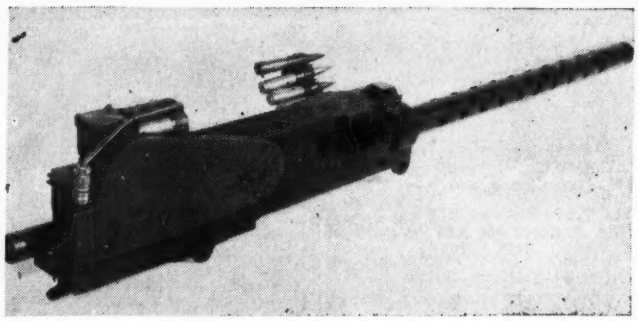
TCA has established a central reservations control office at Toronto to cope with increased passenger traffic. The office makes it possible to ascertain name, address, and destination of any passenger holding space, or in the course of a flight on any TCA plane, within approximately 30 sec. Direct wires connect with western reservations control at Winnipeg, Atlantic reservations at Halifax, and New York. A staff of 70, 66 of them women, keeps the office open 24 hr. a day.

By F. H. Fullerton

A twin-engined CPA plane landed at Edmonton, Alberta recently, completing the 20th flight over the proposed new route from Regina. Application to operate the line is before the Dominion Department of Transport. Service, if approved, will be maintained twice-daily over the new route.

St. Lawrence Div. of CPA has held its first district traffic conference in Montreal. Modern airline procedure and "off-line" operations were discussed. From Montreal east to Quebec City and Arvida, CPA operates with all the luxury of any other line. But east and north to Rimouski and along the north shore of the St. Lawrence, mail, dogs, and furs must be considered on equal terms with passengers, a fact resulting in diverse problems with passengers, baggage and express handling, and reservations.

A giant hydraulic "porcupine" press capable of punching 388 riveting holes in a single stroke is turning out bomb bay catwalk parts ready for riveting 30 times faster than by the previous method of drilling, Boeing Aircraft Co., announces at Vancouver, B. C. Boeing expects that the porcupine will pay for itself in a year.



GETS GUNNERS OUT OF JAM

Mounted on Browning 50-cal. M2 aircraft machine gun, electric device developed by Eureka Vacuum Cleaner Co. clears jams and ejects dud-shells automatically in three seconds.

Obituary

Harry H. Perkins, 53, one of the organizers of Robertson Aircraft Corp., St. Louis, successively its secretary-treasurer, vice - president, and president, a post he resigned in 1929 because of health. Subsequently he managed the four Hunter brothers, who, in 1930, set a 553-hr. endurance record.

Maxwell Jay Rice, 43, assistant vice-president of Pan American Airways which he joined in 1928, subsequently officer of several of its South American affiliates, recipient from the Brazilian government in 1941 of the Order of Southern Cross, Grade of Official, and onetime president of American Chamber of Commerce for Brazil.

Navy Hunts Subs Alone

AAF's Anti-submarine Command has withdrawn from operations, and the Navy, which has acquired more planes and crews for the purpose, has assumed full responsibility.

AAFAC, an outgrowth of the First Bomber Command which since Dec. 8, 1941, has been engaged in anti-submarine activities, was activated in Oct, 1942, under Brig. Gen. W. T. Larson.

★ SPOT CHECKING ★

Plan for postwar readjustment bonuses, payable to company employees who stay on the job during the war, has been drafted by Donald W. Douglas, president of Douglas Aircraft. Already adopted by the board of directors, the proposal awaits approval by government officials.

Test flights of Fairchild's new war-cargo transport plane are now expected in a few months.

Stratosphere effectiveness of new heavy caliber aircraft cannon will be tested in a vacuum-chamber firing range now being completed at Eglin Field, Fla., by York Corp. refrigeration engineers. The new range will duplicate 9-mi. altitudes and—70 deg. temperatures in order that the AAF may determine how lack of oxygen and sub-zero weather influences detonation and projectile speed.

Ninetieth anniversary was recently marked by Bausch & Lomb. More than 3,000,000 lb. of optical glass has been produced by the company since Pearl Harbor.

Policy of exclusive hiring of discharged military veterans for its hourly work is being tried by General Aircraft Corp., Astoria, L. I., builder of CG-4A gliders.

Because long hops on postwar flying schedules may necessitate the preparation of certain dehydrated foods en route, United Air Lines' research kitchen has been testing the feasibility of mid-air cooking. In her experiments, Dietitian Jean Arbogust has made sample meals in pressure cookers placed in the company's altitude test chamber.

Horizon Clubs, senior division of the Camp Fire Girls, recently completed a study of the role of aviation in the modern world. NAA lauded the program for its value in broadening the aviation knowledge of the women of tomorrow.

New annual trophy for the glider pilot making the longest official soaring flight was set up in the will, recently probated, of Maj. Lewin B. Barringer, soaring champion, lost in a crash in the Caribbean. Stipulated is a flight from any launching other than towing.

Inaugurating a project of the U. S. Grazing Service in Idaho to re-seed rangeland from the air, Clyde Bryant recently re-seeded a 2,000 acre tract via airplane in 3½ hr. It's estimated the job would have taken 30 days by the old method, employing three men and a tractor.

Westinghouse has drafted a reconversion plan whereby it can resume production of peacetime electrical items within a few weeks after the war ends.

Convening in Detroit's Book-Cadillac Hotel (Jan. 10-14) is annual SAE war engineering meeting.

Official passengers, other than those of diplomatic and supply-mission status, may now be carried by the air services of both Britain and the U. S. without charge. This agreement, recently reached, is based on Lend-Lease and reciprocal aid practice.

★ MILITARY MEMOS ★

First World War pilots who won wings before Nov. 11, 1918, are eligible for membership in fraternal Order of the Daedalians, founded in Mar., 1934, with the late Brig. Gen. Harold Lee George as wing commander. Present wing commander is Col. Charles H. Dowman, Room 4C-261, Pentagon Bldg.

Through Stockholm come reports that Germans are building two new planes, one a Heinkel four-engine "rocket"-propelled bomber, the other a Messerschmitt two-engine fighter. Both are described in sensational terms usually produced by anxiety. Night fighter pilots, it is reported, have been ordered to suicide-dive their planes into bombers when their ammunition runs out. RAF losses, nevertheless, have declined.

Berlin casualties, reports Berne, had reached 200,000, dead, wounded, and missing during the first three weeks' RAF offensive. But sober estimation was that the end of Nazism through internal crack-up is not yet in sight.

Service changes: Maj. Gen. R. Mitchell, MC, to direct air activity in the Solomons; Brig. Gen. Frank O'D. Hunter, commander of 1st Air Force, to major general; also made major general, Brig. Gen. Frederick L. Anderson, commander of 8th Air Force bombers; to brigadier general, Col. Leon W. Johnson, leader of attack on Ploesti. Col. Lloyd T. Jones has taken command of Fort Dix (N. J.) air base, and Rear Adm. Elliott Buckmaster has taken direction of San Diego Naval Air Base.

Six more airfields have been completed in England by American engineers who plan to run the eventual total up to 100. For every one of them, Britain is contributing $4,000,000. In near future, $552,000,000 of $2,500,000,000 being presently put into U. S. and RAF air attack, will go for 8th Air Force fields.

Losses of only one-half of 1 percent were sustained during year ending last Sept. 30 on trans-Atlantic flights in both directions by planes of U. S. and British military and BOAC.

War Dept. has decorated 1,548 officers and enlisted men who participated in Ploesti raid, and 8th Air Force has honored 550 officers and men.

Seventh Air Force *Liberators* have flown what is termed a record distance of 2,200 mi. in raid against Marshall Is.

New Zealanders have rung up 5-to-1 victory ratio against Jap flyers.

Remarkable ratio of 65 Jap planes with loss of only three planes and two pilots has been scored in two months by flyers of one U. S. carrier.

★ CALLING NAMES ★

John R. Bair, formerly Selective Service supervisor, is now personnel manager of Thompson Products, Inc., Los Angeles. Assisting him are **K. O. Kowie, Clyde B. Leech,** and **Miss Eileen Kennedy.**

G. W. Stratton, chairman of the board of Raymond De-Icer Co., has been elected to the executive committee of the Aircraft Parts Manufacturers Assn.

Vernon L. Gunn, district traffic manager for TWA at Dayton, Ohio, was promoted to the newly-created post of asst. to the central region traffic manager with headquarters in Chicago.

Capt. Norman M. McNeil was appointed chief, flight test section for PCA.

William Hyndman, 3rd, has joined the engineering sales staff of Atlas Tool & Designing Co.

Sloan Taylor, aviation editor of the *N. Y. Daily News,* heads the new list of officers as Commander of Air Service Post, No. 501, American Legion. The following were elected vice-commanders: **Capt. Kenneth P. Behr,** asst. manager LaGuardia Airport; **Frank T. Coffyn,** president of the Early Birds; **Maj. Lester D. Gardner** of the Institute of the Aeronautical Sciences; **F. E. King,** attorney and former naval pilot; **Major Clayton Knight,** World War I flyer and aviation artist; and **Samuel F. Pryor, Jr.,** v. p. Pan American Airways. **Dr. Joseph R. O'Donnell** was re-elected adjutant.

The Boston Aero Club, claimed to be the oldest aeronautical club in the world (it was founded Jan. 2, 1902), elects the following officers: **John P. Gilbert,** public relations director for Northeast Airlines, president; **Warren A. Smith,** 1st v.p.; **Benn B. Follett;** 2nd v.p.; **Pierce Edmunds,** secy.; **Kenneth Perkins,** treas.; **Godfrey L. Cabot, James A. Tower, H. Helm Clayton, W. C. Hill, Parker Milliken,** and **Capts. Milton H. Anderson, A. A. Lane,** and **Stafford Short,** directors.

Henry Beeken is appointed research asst. to Pres. C. Bedell Monro of PCA.

Guy M. Springer is appointed asst. to the vice-president of Braniff Airways and will have charge of airmail and air express.

Dr. Rowland Burnstan, formerly director of the aeronautical division of Minneapolis-Honeywell, was elected a member of the board of Lawrance Engineering, and executive v.-p. and general manager. **Alfred Marshall** was named as his assistant.

O. T. Larson, TCA v.-p. is on leave of absence to fulfill, in a civilian capacity, a war-effort assignment for the United Nations overseas.

Comdr. P. H. Lyon has assumed the duties of supt. of aviation training at the Naval Air Training Center, relieving **Comdr. Cameron Briggs,** USN, who was detached for duty afloat.

Douglas Aircraft announces the following changes: **A. E. Farr** becomes supervisor of the mechical controls section; **V. D. King,** general supervisor of a new "change control" department; **J. E. Owens** becomes plant engineer; **J. E. Romais** is appointed chairman of the employee-management war production committee of the Chicago plant; **Kingdon Kerr** is appointed special project engineer; **G. M. McKenzie** is named coordinator of the feeder plant system; **C. W. Berto** is promoted to shift supt.; **Earl T. Bush** becomes supervisor of field operations; **C. S. Glasgow** is appointed asst. chief engineer of the mechanical section; **Lloyd H. Cooper** is named staff asst. to **Harold Hynd,** newly appointed manager of the new modification center. **W. H. Hunt,** supervisor of flight operations at Santa Monica, has won his 15-yr. service pin. **C. C. "Chet" Pearson,** manager of the Oklahoma City plant, is celebrating his organization's first year of production of C-47's.

Miss Verna Ingham is assigned stewardess field supervisor of American Airlines and will be based at Memphis. **R. W. Baker,** formerly supervisor of reservations and ticket offices in Washington, is appointed eastern supt. of reservations and ticket offices in New York. He is replaced in Washington by **Donald Urquhart.**

J. J. McVeigh, one of UAL's "pioneer" employees, transfers from his Allentown station managership to the LaGuardia dispatch office. **Benjamin Bullard, Jr.,** former Moline, Ill., station attendant, takes over the Allentown managership. **E. A. Bauman,** North Platte, moves to Cheyenne as asst. to **C. B. Hempel,** station manager, and **S. M. Hadden, Jr.** succeeds Bauman. **G. Daniel Boon** moves to Indiana to replace Hadden. **Maurice L. Perry** is appointed supt. of counter service at Chicago. **James P. Dean,** with the New York traffic office for the past 10 yr., is named district traffic representative at Hartford, Conn.

Herman R. Thies, former asst. manager of the Goodyear Research Laboratory, is appointed manager of the company's newly organized plastics and chemical sales division.

Harry S. Murray joins Braniff Airways as asst. to the president. He comes to Braniff from the War Manpower Commission, where he has been doing special personnel and training work.

D. A. Beck, formerly with Glenn L. Martin in Baltimore, is named asst. manager of Goodyear's general design engineering.

The newly-formed Douglas research laboratories will include **H. E. Guerin,** factory manager; **J. M. Schumann,** tooling director; **F. R. Collbohm,** engineering executive asst.; **A. T. Kuehner,** plant engineering director; and **M. G. Simpson,** quality standards director, on its research program board. Immediate problem of research laboratories will be handled by departmental heads—**D. C. Parker,** administrative engineer; **Dr. J. E. Lipp,** research manager, and **W. L. Horton,** laboratory supt.

Clarence O. Burgin is named executive staff assistant for Chicago & Southern Air Lines. His work will consist chiefly of roving assignments. **John A. Nooney** resigns as treasurer and plans opening his own auditing firm with headquarters in St. Louis. His firm will continue to handle the C & S account, and he will also act as advisor on tax matters and accounting problems.

Charles F. Carr is now secretary-treasurer of Aircooled Motors; **Joseph Babcock** becomes production manager; and **Walter W. Burrows** is now administrative engineer.

HUNTER *Electro*-Copyist *to the Rescue...*

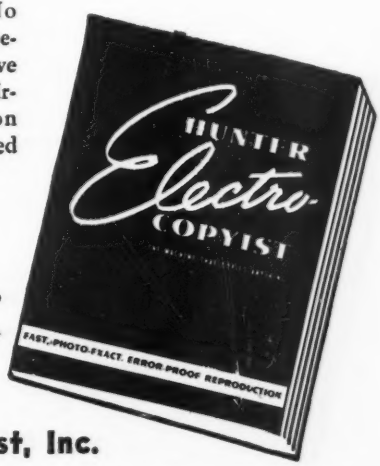
of Understaffed Drafting Rooms

• Hunter Electro-Copyist speeds up operations in the drafting room from the moment the first "rough" is finished. For example, if several persons must pass on the preliminary pencil sketch, copies can be made directly from it in a few minutes, and all can study it simultaneously. Alterations can be made, and new copies struck without changing the original, simply by blocking out the desired portion and drawing the changes on the reproduction.

• Nor is it necessary to make ink tracings. Again in a few minutes, the Hunter Electro-Copyist turns out a machine-made tracing that is sharper than the pencil original. It requires no tedious checking and is both error-proof and smudge-proof.

• When it comes to final copies, the Hunter Electro-Copyist can turn them out as fast as you want, as many as you want, with every line and every shade gradation exactly duplicated, on your choice of three weights of paper, on vellum or on tracing cloth.

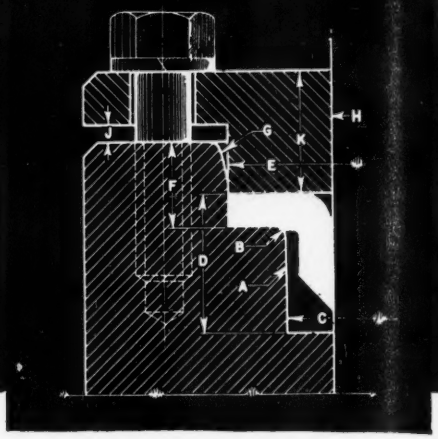
• There is a wide range of models, from letter size to the 48" x 168" big boys specially developed for the aviation industry. Ask for a demonstration and analysis of your reproduction work. No obligation. If you prefer, send for descriptive booklet, which is virtually a treatise on photo-copying applied to industrial needs.



ASK FOR IT . . . →

HUNTER
Electro-Copyist, Inc.
476 S. WARREN ST. • SYRACUSE, N. Y.

GRATON & KNIGHT ENGINEERS *Present* PACKINGS POINTERS



THE FLANGE (or "Hat") PACKING

The flange packing is self-sealing at its inside periphery — just the opposite of a cup packing.

With rare exceptions, it has only one application — in a packing recess, to prevent the passage of the medium along the shaft or piston rod.

It is installed with the sealing lip facing the pressure medium. Sealing contact between the piston rod and the inside periphery is maintained by the pressure of the medium in the system; sealing contact between the flanged surface and the stuffing box is provided by tightening the gland on the flanged area.

The flange is most successfully applied where the pressure is not too great. Typical applications are as a dust seal, oil seal or wiper. It has the advantage of being removable for reinstallation; the conventional metal-encased retainers which are pressed into a housing, are usually destroyed by removal.

MAIN ADVANTAGES

1. *Low first cost.* Also: machining is simple; no special finishing required for surfaces of packing recess and gland. **2.** *Minimum space.* **3.** *Easy installation.* Flanged part of packing is mechanically sealed by tightening the gland. **4.** *No rotation.* Flange, compression-sealed with gland, has only one mechanical sealing surface (the inside periphery). No danger of packing rotating with rotating shaft.

DESIGN FEATURES

A. Packing Recess

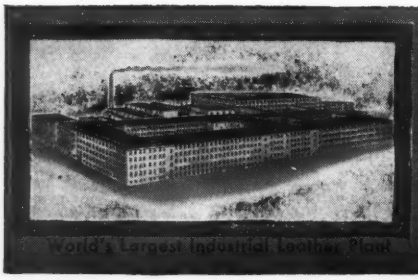
1. Outside diameter (E): equal to outside diameter of packing.
2. Inside diameter (G): equal to shaft diameter plus 2½ times thickness of leather. This allows clearance (A) between vertical wall of recess and flange equal to approximately 25% of packing thickness, to prevent binding and for ease in assembling.
3. Depth (D): equal to overall height of packing plus (usually) 1/16 of an inch. The extra clearance allows free admission of the medium to the packing recess.
4. Depth (F): enough to center the gland or packing follower.
5. Corner (B): chamfered or rounded to avoid cutting the packing.
6. Corner (G): chamfered.

B. Gland (or Packing Follower)

1. Bolted Gland (Fig. 1): Clearance (H) between inside diameter of gland and the shaft must be minimum, in order to give the flange proper backing . . . depth of gland (K) should be sufficient to insure enough clearance at (J) so that tightening the bolt will develop a compression seal on the base of the packing. If clearance is excessive at (H), a metal washer can be installed to properly support packing.
2. Threaded Gland, with protective washer between flange and gland, to prevent distortion of flange by tightening of gland.

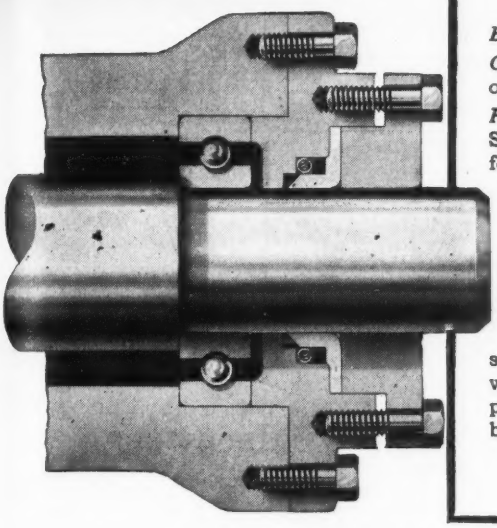
C. Expanders (actually "contractors", in case of flanges)

1. Finger Type Expander: phosphor bronze type is most efficient, but is usually limited to production jobs.
2. Garter Type Expander: coil spring easily wound on an ordinary lathe.
3. Miscellaneous Expanders: rubber or synthetic rubber, braided flax, hemp, etc.



GRATON & KNIGHT *Engineering*

GRATON & KNIGHT
Recommendations at the
"PACKING POINT"



CASE NO. 1

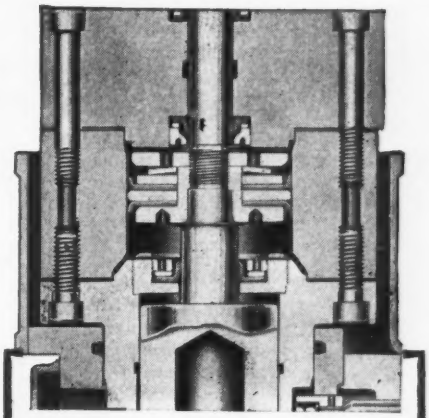
OIL SEAL APPLICATION

Equipment: rotating shaft.

Operating conditions: used as oil retainer with coil spring.

Packing recommended: Spartan leather especially treated for oil.

Accessories: close-wound coil spring, contracting the inside diameter of the packing, keeping it in sealing contact at the sealing point, without causing excessive friction. It will maintain tension even after considerable wear has taken place on the packing. (Spring not furnished by G & K.)



CASE NO. 2

PNEUMATIC APPLICATION

Equipment: retractible head of welder.

Operating conditions: 125 p.s.i. air.

Packing recommended: Spartan leather especially treated for 125 p.s.i. pressure.

Accessories: In accordance with recommended practice under Fig. 1.

See Graton & Knight Insert in SWEET's File for Product Designers

SPARTAN LEATHER PACKINGS AND A SERVICE THAT BUILDS CERTAINTY AT THE POINT OF SEAL

Graton & Knight's SPARTAN emphasizes the many advantages of leather as a packings material —

wearing quality . . . low coefficient of friction . . . flexibility at low temperatures . . . adaptability to wide range of mediums . . . economy

and adds the following qualities, which result from the exclusive Graton & Knight SPARTAN tannage —

the resistance to heat and oil of top-quality chrome leather . . . a mellowness, flexibility and body not found in the usual chrome tannage.

Spartan has highest resistance to heat (withstands boil test), and will not dry out hard and brittle. It is acknowledged the top-quality leather in the packings industry.

The combination of proper selection of sealing material plus correct application has made Graton & Knight engineers the No. 1 source of practical, time-saving aid for machine designers.

When your design reaches the "packing point" — or when a packing trouble arises — call on G&K engineers.

the hand that builds certainty at the point of seal

GRATON & KNIGHT COMPANY

WORCESTER 4, MASSACHUSETTS

GRATON AND KNIGHT

Aviation Manufacturing

Baruch Injects Idea of WPB Supervision Into Turmoil of Conversion Suggestions

Washington (AVIATION Bureau)—Plans for conversion and transition to peace production are taking shape slowly because: 1. war monopolizes the attention of most leaders in government and business, 2. because the problem is extremely difficult, and 3. because jealousies and conflicting interest hinder progress.

Even the Administration and Congress are in a contest for power over the postwar economy. The President can decide whether Donald Nelson, James F. Byrnes, Charles Wilson, or Bernard Baruch, will be the over-all boss, but Congress can bring pressure and pass laws which will determine their powers.

Mr. Baruch, who under Administrator Byrnes, is head of Office of War Mobilization's adjustment unit, has the advantage of experience as head of the War Industries Board in 1914-18 and wields great influence. He advocates: 1. quick cash settlements on terminated contracts, 2. demobilization by the same agencies that organized industry for war (Army, Navy, Maritime Commission, etc., would terminate contracts, dispose of plants, and handle surplus equipment), but 3. all agencies would function under a single head—WPB. Baruch also advocates a separate office to dispose of invoices of raw materials.

Second to contract termination, the aircraft industry is interested in disposal of government owned plants. No one has any crystallized ideas on how, except that the government should not be allowed to operate them under any circumstances. Most observers agree that aircraft plants are not extensively convertible.

Third, the industry is concerned about the method of liquidating surplus planes. Baruch and many other leaders feel that all usable and convertible planes can be "judiciously" sold, over a period of time, at home and abroad without too much damage to the market.

Aviation Distributors and Manufacturers Assn. proposes a seven-man federal commission, to be appointed by the President, to conduct orderly disposal of surplus materials to prevent "disastrous liquidation." Aeronautical Chamber of Commerce representatives have recommended to Congressional committees prompt cash settlements on terminated contracts along the lines proposed by the National Aircraft War Production Council.

The industry will have to stay on maximum production to the last bugle. If transition is not well organized, there will be a mad rush for the exits, for other lines of war production will have already gone back to peace work.

No less than five or six Congressional committees are working on these transition problems. It seems probable that the postwar planning committee of Sen. Walter F. George will become the clearing center of Congressional ideas.

Budd Steel Cargo Plane Completes Test Flight

The stainless steel cargo plane, contracted for by the Navy with Edward G. Budd Mfg. Co. a year ago, was recently test flown. Navy says only that it is a two-engine ship, that performance is satisfactory, and that production will be shared with the Army.

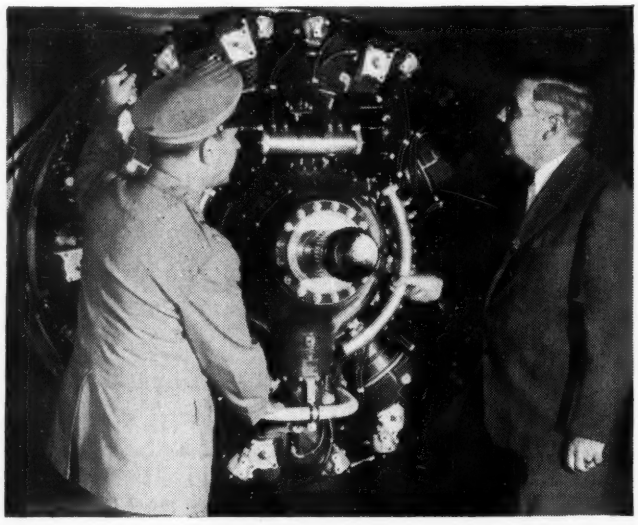
It is known, however, that this is the design developed before Pearl Harbor by a committee representing the Aviation Section of the South American Republics Div. of the Reconstruction Finance Corp. The idea was to substitute steel for aluminum, the supply of which was then inadequate.

It is believed that the present Budd plane has a tricycle landing gear, is all-welded steel, has three doors, weighs about 30,000 lb. gross, and is slightly larger than a DC-3. Reports are that a two-ton truck can be taken aboard, fully loaded. The wings are high, but the engines are below them, permitting two of the landing wheels to be retracted into the nacelles.

Navy officials refused to discuss the present need for steel construction.

Original design of the plane was for operation from high elevation or restricted fields in Central and South America as a substitute for the JU-52's when the Axis was forced out of this hemisphere. This plan was dropped because of difficulties in arranging orders.

New Wright "Cyclone" in Service



Myron B. Gordon (right), vice-president and general manager of Wright Aeronautical, discusses features of new 2,200-hp "Cyclone" with Lt. Col. Carl R. Borkland, AAF resident representative.

The new 2,200-hp. *Cyclone* engine, one of the most powerful service types in existence, is being used on the Lockheed C-69 *Constellation* and on undisclosed military craft, its maker, Wright Aeronautical Corp., announces.

Development work, which started before the war, has resulted in a power plant with a double row of nine cylinders displacing 3,350 cu.in. Frontal diameter of 55 in. is the same as that of the 525-hp. *Cyclone* of 1927. Manufacturing is being done in a specially designed factory, and an automotive company has been licensed for quantity production.

Construction features include a nose section especially designed to permit use of a close-fitting cowl to decrease air resistance. Aluminum alloy cylinder heads and nitralloy steel cylinder barrels are used. A steel crankcase permits taking more power from the engine than would be possible with an aluminum one and with magnesium used in the nose section and supercharger housing. Weight is slightly over 1 lb. per horsepower.

To transmit the 2,200 hp. to the propeller at most efficient speeds, a reduction gear system was designed. It is believed by Wright engineers to have the lowest ratio ever used on any engine. Very large, broad-bladed propellers keep blade tip speeds within efficient limits, and propeller rpm. is less than half that of the crankshaft—at some cruising speeds as low as 600.

November's Record 8,789, Includes 1,000 Big Bombers

Washington (AVIATION Bureau)—November production was 8,789 or 338 planes for every working day. One thousand of the total were four-engine bombers, Boeing B-17's and B-29's and Consolidated B-24's. The schedule calls for still more big bombers.

November's increase of 427 planes over October would have been even greater but for the shortness of the month. WPB announced that deliveries were 97 percent of schedule.

In November through OWI, WPB released a chart showing production relatively in units and tons of airframe weight through May and October. Unit output increased about 19 percent while tonnage of airframes increased about 27 percent.

Some observers said that WPB was preparing to sell the public on accepting tonnage rather than unit production reports. Even if this were the case, the effort would be futile people still want numbers. Tons do not give them a clear picture. The public also refused to accept Liberty and Victory ship output in tons.

AAF Offers Surpluses

The armed services have never printed a list of surplus goods for sale. But last month, AAF set the precedent. The catalog is printed in color and offers 441 items in small mail order sales-talk. Most of the goods—pumps, hose, tanks, cranes, tools, etc—are represented as suitable for industrial use. All the merchandise is held by the 8300th Air Force, Memphis, Tenn.

REPORTS FROM MANUFACTURERS

A record B-17 output, which reached an all-time high at the end of the third quarter of last year, was achieved, Pres. P. G. Johnson reported, despite lack of additional manpower to meet upward schedule curves. Efficiency, however, doubled output in a year while the number of employees remained stationary and nearly half the men were replaced by inexperienced women. Additional workers, particularly riveters assistants, are still needed.

Two other manufacturers report on contract work for Boeing. Hamilton Standard announces that the B-29 will be equipped with hydromatic propellers nearly 17 ft. dia. which are also being produced under license by Frigidaire. Bendix is in volume production of new .50 cal. "chin turrets" recently revealed as standard armament of B-17's. Its production of power turrets, Bendix says, has increased approximately 800 percent since 1941.

Since Pearl Harbor, reports Bendix' Eclipse-Pioneer Div., production of more than 70 types of instruments and engine components has reached more than 75,000 units a month.

Consolidated Vultee announces that WPB has rated it first in three production classifications, heavy bombers, single-engine bombers, and basic or advanced trainers and utility cargo transports. During three months of the period considered in the Board's survey *"Liberator* output in terms of airplane pounds per employee was 30 percent better at San Diego than that of any other manufacturer of heavy bombers," it was said by Pres. Harry Woodhead.

General Motors Chevrolet Division reports that its November production of 1,200-hp., 14-cylinder P & W engines was the largest ever achieved by any manufacturer.

Two substantial orders for Franklin engines have been received by Aircooled Motors Corp., Syracuse, N. Y. War Training Service and the Brazilian government are purchasing 65 hp., horizontally opposed air-cooled types for training planes. WTS is also taking a number of Franklin 90-hp. models.

Tripled over a year ago, Elastic Stop Nut Corp.'s production of self-locking fasteners is now highest in history.

Defense Plant Corp. has increased its advances to Continental Aviation and Engineering Corp., Detroit, by an additional $40,000,000 for plant facilities in Muskegon County, Mich.

Aeronautical Chamber Contemplates Changes

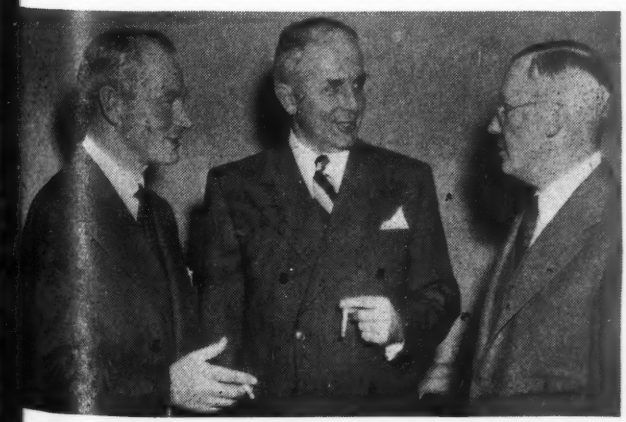
Following recent annual meeting of the Aeronautical Chamber of Commerce, several organizational changes are anticipated.

Aircraft Industries Assn. has been suggested as new name for the Chamber, but this title must be ratified by the membership.

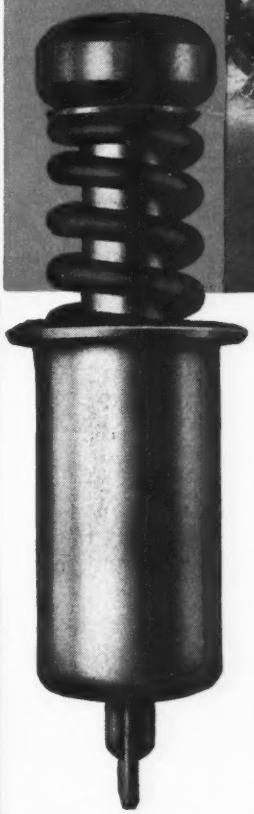
A group of some 200 wants to exclude from membership all those not directly connected with manufacturing.

Up for election is a new board of governors expected to include heads of six West and six East Coast airframe and/or engine makers, two parts manufacturers, and one representative of other members. Regular meetings, coinciding with those of the War Production Councils, would be held alternately on West and East coasts.

Chamber Pres. James P. Murray of Boeing indicates that his immediate successor will serve only until a full-time chief executive is appointed.



Director of Aero Chamber's newly created department on personal plane problems is John E. P. Morgan (left) who discusses plans with Norris Dumper, director of aviation for Coordinator of Inter-American Affairs, and Col. Harrison Brand, Chamber general manager. (Harris & Ewing photo.)



You test it . . .
they did . . .
and found it worth-while

THE LOXIT SKIN FASTENER . . . was recently tested by laboratory technicians at Consolidated Vultee Aircraft Corporation, builders of the famous Liberator B-24 Bomber. Results substantiated every claim made.

SAFER . . . special design and rugged construction adds increased safety factor. Appeals to women workers.

FASTER . . . simply line up skin holes . . . compress . . . snap and it's in.

EASIER TO USE . . . LOXIT Skin Fasteners need to be held in compression only at instant of application. Motion studies show this saves 75% of worker fatigue and speeds operation an average of 10%.

LONG-WEARING . . . hardened steel body shell and heat-treated plunger reinforced by tubular sleeve increases life span.

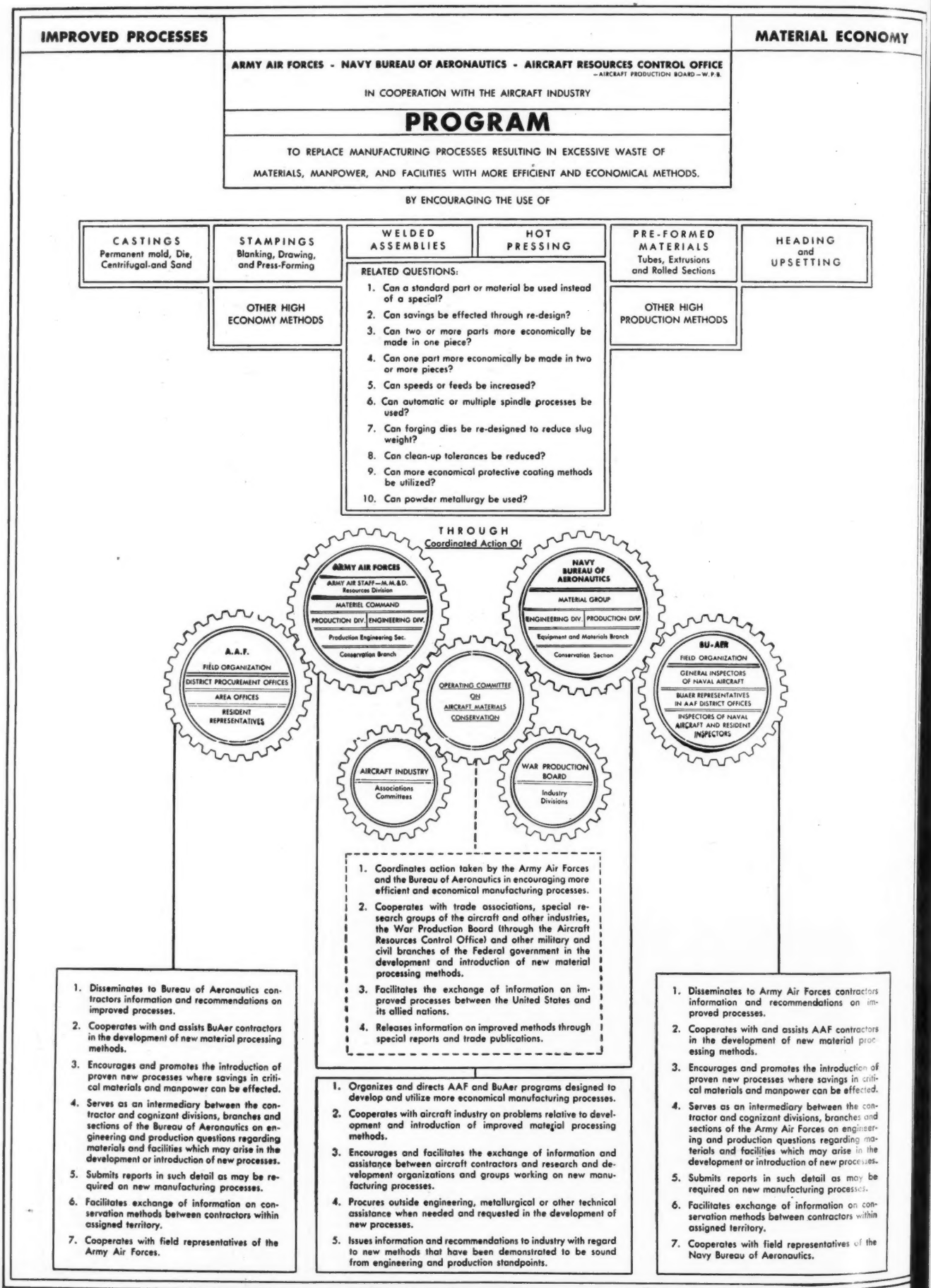
SMALLER . . . easier to handle in close quarters, particularly near right angle bends.

FREE SAMPLES

A request on your business letterhead will bring you LOXIT Skin Fasteners for your testing. You'll find it fits any standard type pliers or gun. Write today. Scovill Manufacturing Company, 20 Mill Street, Waterbury, Connecticut

LOXIT SKIN FASTENERS
SPEED THE JOB
. . . A SCOVILL PRODUCT

New Program to Increase Manufacturing Efficiency Charted by Army and Navy


IMPROVED PROCESSES
MATERIAL ECONOMY
ARMY AIR FORCES - NAVY BUREAU OF AERONAUTICS - AIRCRAFT RESOURCES CONTROL OFFICE
– AIRCRAFT PRODUCTION BOARD – W.P.B.
IN COOPERATION WITH THE AIRCRAFT INDUSTRY
PROGRAM
TO REPLACE MANUFACTURING PROCESSES RESULTING IN EXCESSIVE WASTE OF
MATERIALS, MANPOWER, AND FACILITIES WITH MORE EFFICIENT AND ECONOMICAL METHODS.
BY ENCOURAGING THE USE OF
CASTINGS
Permanent mold, Die, Centrifugal-and Sand
STAMPINGS
Blanking, Drawing, and Press-Forming
WELDED ASSEMBLIES
HOT PRESSING
PRE-FORMED MATERIALS
Tubes, Extrusions and Rolled Sections
HEADING and UPSETTING
OTHER HIGH ECONOMY METHODS
OTHER HIGH PRODUCTION METHODS
RELATED QUESTIONS:
1. Can a standard part or material be used instead of a special?
2. Can savings be effected through re-design?
3. Can two or more parts more economically be made in one piece?
4. Can one part more economically be made in two or more pieces?
5. Can speeds or feeds be increased?
6. Can automatic or multiple spindle processes be used?
7. Can forging dies be re-designed to reduce slug weight?
8. Can clean-up tolerances be reduced?
9. Can more economical protective coating methods be utilized?
10. Can powder metallurgy be used?
THROUGH
Coordinated Action Of
ARMY AIR FORCES
ARMY AIR STAFF—M.M.&D. Resources Division
MATERIEL COMMAND
PRODUCTION DIV.
ENGINEERING DIV.
Production Engineering Sec.
Conservation Branch
NAVY BUREAU OF AERONAUTICS
MATERIAL GROUP
ENGINEERING DIV.
PRODUCTION DIV.
Equipment and Materials Branch
Conservation Section
A.A.F.
FIELD ORGANIZATION
DISTRICT PROCUREMENT OFFICES
AREA OFFICES
RESIDENT REPRESENTATIVES
OPERATING COMMITTEE ON AIRCRAFT MATERIALS CONSERVATION
BU-AER
FIELD ORGANIZATION
GENERAL INSPECTORS OF NAVAL AIRCRAFT
BUAER REPRESENTATIVES IN AAF DISTRICT OFFICES
INSPECTORS OF NAVAL AIRCRAFT AND RESIDENT INSPECTORS
AIRCRAFT INDUSTRY
Associations
Committees
WAR PRODUCTION BOARD
Industry Divisions
1. Coordinates action taken by the Army Air Forces and the Bureau of Aeronautics in encouraging more efficient and economical manufacturing processes.
2. Cooperates with trade associations, special research groups of the aircraft and other industries, the War Production Board (through the Aircraft Resources Control Office) and other military and civil branches of the Federal government in the development and introduction of new material processing methods.
3. Facilitates the exchange of information on improved processes between the United States and its allied nations.
4. Releases information on improved methods through special reports and trade publications.
1. Disseminates to Bureau of Aeronautics contractors information and recommendations on improved processes.
2. Cooperates with and assists BuAer contractors in the development of new material processing methods.
3. Encourages and promotes the introduction of proven new processes where savings in critical materials and manpower can be effected.
4. Serves as an intermediary between the contractor and cognizant divisions, branches and sections of the Bureau of Aeronautics on engineering and production questions regarding materials and facilities which may arise in the development or introduction of new processes.
5. Submits reports in such detail as may be required on new manufacturing processes.
6. Facilitates exchange of information on conservation methods between contractors within assigned territory.
7. Cooperates with field representatives of the Army Air Forces.
1. Organizes and directs AAF and BuAer programs designed to develop and utilize more economical manufacturing processes.
2. Cooperates with aircraft industry on problems relative to development and introduction of improved material processing methods.
3. Encourages and facilitates the exchange of information and assistance between aircraft contractors and research and development organizations and groups working on new manufacturing processes.
4. Procures outside engineering, metallurgical or other technical assistance when needed and requested in the development of new processes.
5. Issues information and recommendations to industry with regard to new methods that have been demonstrated to be sound from engineering and production standpoints.
1. Disseminates to Army Air Forces contractors information and recommendations on improved processes.
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7. Cooperates with field representatives of the Navy Bureau of Aeronautics.

Societies Elect Officers

New officers have been elected by three societies.

Society of Automotive Engineers: President, W. S. James; vice-presidents representing aircraft engineering, R. D. Kelly and A. T. Gregory; members of the Council (two years), L. Ray Buckendale, Robert F. Steeneck, and Harold T. Youngren. Arthur Nutt will serve for one year on the unexpired term of J. C. Zeder. Due to the death of Nominee David Beecroft after ballots were mailed, the Council will name a treasurer. Other new vice-presidents are A. J. Blackwood, J. R. Sabina, Earl H. Smith, E. C. DeSmet, J. E. Hacker, O. R. Schoenrock, E. W. Templin, and E. M. Schultheis.

New officers of American Welding Society are David Arnott, president; Isaac Harter, 1st vice-president, and A. C. Weigel, 2nd vice-president. Directors: H. W. Pierce, E. R. Seabloom, K. V. King, and J. H. Deppeler. Regional vice-presidents: F. C. Fyke, C. H. Jennings, G. N. Sieger, E. C. Chapman, and J. C. Gowing.

Incoming officers of National Safety Council's Aircraft Manufacturing Section are R. B. Carter, W. H. Rhodes, A. A. Hendrix, R. L. Woods, A. D. Caddell, J. A. Pigue, and I. E. Martin.

New Engine Booster

Republic P-47 *Thunderbolts* and certain Navy fighters are reported getting extra bursts of power from a new "water injection device" attached to their 2,000-hp. Pratt & Whitney *Double Wasps*. Specific details of this booster's operation are not revealed, but P & W says its advantages are greater cooling effect of vaporization in cylinder, lessened susceptibility to detonation, and more power from resultant leaner mixtures.

Plan 5-Fold P-38 Output

Production schedule for P-38 *Lightnings* five times greater than that of a year ago is announced by Lockheed Pres. Robert E. Gross. Consolidated Vultee's Nashville plant is also to go into P-38 production.

Contracts for production of CG-4A gliders by Timm Aircraft, Los Angeles, have been cancelled and Timm production facilities turned to P-38 subcontracting. Others brought into the program include Hudson Motor Car, Rheem Mfg., Convair's Vultee Field Div., and Weber Showcase & Fixture Co. and Avion, Inc., both of Los Angeles. Lockheed will fabricate fuselages, forward booms and tail surfaces but subcontract other components.

Merger of Vega Aircraft Corp. into Lockheed with elimination of the name Vega has now been effected. Courtland Gross, formerly president of Vega, has become vice-president and general manager of Lockheed. Mac Short, formerly Vega vice-president of engineering, is directing P-38 subcontracting.

PRODUCTION-BATTLE CITATIONS

★ Three Stars ★

Electric Storage Battery Co.
Grumman Aircraft
International Resistance Co.

★ Two Stars ★

Independent Pneumatic Tool Co.
R. Hoe & Co.

★ One Star ★

Bendix Aviation Corp. (Eclipse-Pioneer Div.)
Firestone Tire & Rubber Co.
Ladish Drop Forge Co.
I. F. Laucks
Pesco Products Co.
Sundstrand Mach. Tool Co.
Weatherhead Co.
Whiting Corp.

Army-Navy "E"

The Cleveland Planer
Cook Electric Co.
Elgin National Watch Co.
Four Wheel Drive Auto Co.
General Motors (Delco Radio Div.)
George K. Garrett Co.
Koehring Co.
Posey Mfg. Co.
Raybestos-Manhattan (Manhattan Rubber Mfg. and Raybestos Divs.)
Schrillo Aero Tool Co.
Square D Co. (Kollsman Instrument Div.)
Yale & Towne Mfg. Co.

Scheduling Restricted; "Attrition" Still Problem

New WPB order M-360 restricts scheduling to only those parts, components, and subassemblies which come under the jurisdiction of its Aircraft Resources Control Office. Requirements are to be filed by manufacturers with the Aircraft Scheduling Unit, Wright Field. It will check material requests against supplies available and production schedules.

Aircraft Scheduling Unit reports that the industry has been cooperative in returning unused quarterly material allotments, but that the problem of "attrition" — failure of manufacturers to make full use of Controlled Materials Plan ratings—has not been completely solved. In one recent quarter 20 percent of gross amounts allowed were returned. The Scheduling Unit has commenced a campaign for quick return of unneeded supplies during the first and second quarters of this year, and recommends that manufacturers maintain adequate material control systems.

★ FOR THE RECORD ★

Standard Accident Insurance Co., Detroit, has joined United States Aircraft Insurance Group.

Automotive Parts & Equipment Manufacturers association has changed its name to Automotive & Aviation Parts Manufacturers, Inc., and is expanding its intelligence service for the benefit of companies making aircraft parts. Membership, now 400 in 26 states, will be open to firms engaged exclusively in aviation work, but all must be manufacturers.

Aeronautical engineering firm of Michael, Gregor & Associates has been organized to handle tooling, designing, research, etc.

Aircraft Tools, Los Angeles, announces addition of a tool repair division.

Palnut Co. (self-locking fasteners) has opened regional offices in Detroit.

Quigley Co. has removed to 527 Fifth Ave., New York 17.

ASSEMBLY LINES

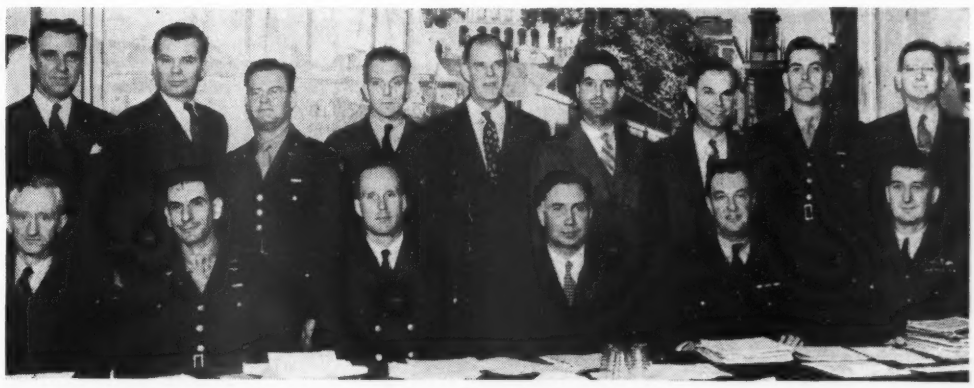
Ford is making plastic distributor heads for *Allisons* from a moisture- and arc-resisting thermosetting compound which decreases weight. The design changes are stated to have tripled strength.

Gasoline that escapes before a tank seals itself is absorbed by new synthetic rubber "overcoat" manufactured by Goodyear.

Plastics and plywood have been substituted for aluminum in 66 *Liberator* parts. Among them: Map cases, cable pulleys and guards, switch boxes, knobs, and handrails.

Since war began, Aluminum Co. capacity for forging has multiplied 45 times and that for fabricated products from 6½ to 13 times. Capacity of 40 government-owned plants is greater than that of all private manufacturers. Annual production of both public and private facilities is now approaching 2,100,000,000 lb.

Elimination of duplicate drawings is reported by Consolidated Vultee's Fort Worth plant through use of X-ray apparatus which reproduces lines scribed on cold rolled steel by a special process involving luminous lacquer.

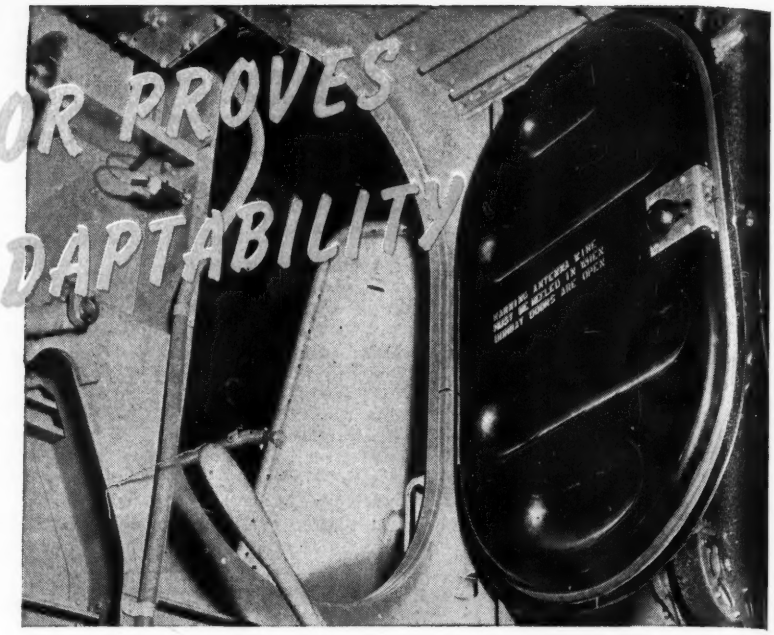


AIRCRAFT STANDARDS COMMITTEE MEETS

Sixth national meeting of National Aircraft Standards Committee in New York was attended by more than 40 representatives of 32 contractors and men from government agencies. Among them (standing left to right) were C. J. J. W. Le May, Australian War Supplies; Eric Dudley, Curtiss-Wright, past National Committee Chairman; Maj. J. M. Miller, AAF, Army-Navy Aeronautical Board; Sq. Ldr. C. H. Skelton, RCAF; Carl Stryker, WPB; Charles Sardou Jr., Convair, West Coast Committee Chairman; J. F. Cox, Vega, National Committee Chairman; Lt. Col. G. R. Gaillard, AAF, Army-Navy Aero Board; and George W. Baughman, Cessna, East Coast Committee Chairman. Seated (l. to r.): C. J. Rowe and Capt. J. P. Vidosic, AAF, both of Wright Field; Lt. J. J. Tigert, USN, Army-Navy Aero Board; W. M. Brown, Flt. Lt. D. G. Moffitt, and Wing Comdr. J. A. Bennett, all of RAF and British Air Commission. Among past year's accomplishments NASC reported effecting reduction of varieties and sizes of steel and dural tubing from 2,790 to 325 respectively and cutting of approximately 100 varieties of rivet types and materials to less than 10.

FUSELAGE DOOR PROVES PANELYTE'S* ADAPTABILITY

FOR LARGE STRUCTURAL PARTS



A—PANELYTE Fuselage Door, open. Note absence of rivets to hold the parts together, intricate molding, and rubber gasket.

PRONOUNCED "revolutionary in its many advantages," the new type PANELYTE Fuselage Door was developed by Panelyte engineers in cooperation with the Glenn L. Martin engineering staff. Its installation in the Martin B-26 "Marauder" indicates the increased use of PANELYTE for larger aircraft parts. If you are using large structural parts whose production should be speeded by straight-line mass production, it will be worth your while to consider the following factors.

WEIGHT SAVING – Inasmuch as the specific gravity of PANELYTE is only one-half that of aluminum, the use of the PANELYTE Fuselage Door effects a worthwhile saving even though the two sections of the PANELYTE unit are slightly thicker than the aluminum. (Added thickness, providing greater rigidity, is a decided asset.)

SUPERIOR RESISTANCE TO VIBRATION – The PANELYTE Door withstands vibration and subsequent oil-canning because PANELYTE'S vibration resistance is far higher than that of aluminum. The damping characteristics of PANELYTE enable this unit to withstand the high and low pressures existing during a bomb run.

PROMPT DELIVERY—AT LOWER COST – Both sections of the PANELYTE Door are molded *in one press in a single operation*, then rapidly vulcanized together, and gasket permanently bonded to flange. Riveting of locks, etc. completes the job—with "on time" shipment assured. The economy of PANELYTE is another point in its favor.

By test and use PANELYTE has long proved its value – in the new and constructive use of flat sheets for airplane skin...molded aircraft flooring and heavy duty cargo flooring – in the production of molded laminated instrument panels, navigators' table drawers, stowage boxes and aircraft pulleys – and in such dramatic developments as push rod housings and the manufacture of hundreds of thousands of engine baffles. PANELYTE Engineers are available for immediate consultation on any problem involving the use of thermo-setting structural plastics for large – or small – parts.

* AMERICA'S LARGEST PRE-WAR MANUFACTURER OF MOLDED AND FABRICATED LAMINATED PLASTIC PARTS

PANELYTE *the structural plastic*

PANELYTE DIVISION
ST. REGIS PAPER COMPANY
230 PARK AVENUE
NEW YORK 17, N. Y.

MASS PRODUCTION OF SHEETS, RODS, TUBES, MOLDED FORMS, FABRICATED PARTS

Sales Offices: Atlanta, Chicago, Dallas, Denver, Detroit, Houston, Kansas City, Los Angeles, Montreal, New Orleans, St. Louis, St. Paul, San Francisco, Seattle, Toronto, Vancouver

Experienced and reliable Fabricators in Industrial Centers from coast-to-coast

Continued Flow of Applications Increases Need For Settling Civil and Foreign Air Policy

Washington (AVIATION Bureau)—Route applications of all kinds are piling up on CAB and thus increasing the pressure for action on both the pending Lea legislation, which would revise the civil air law, and on foreign air policy.

All foreign and many domestic applications depend directly upon establishment of foreign policy, upon clarification of the law, or possibly upon court decisions. A great many of the short route, or so-called feeder and in-flight pickup applications, are awaiting establishment by CAB of a pattern on which to base decisions.

Even if the Lea Bill were enacted immediately the question of competition by ground transportation would not be settled, for amendments dealing with Section 408 were put into a separate bill awaiting later action by the House.

Significant in connection with Section 408 is a request recently filed by the Department of Justice to intervene in the application proceedings of three steamship companies seeking to operate foreign services and in the case of the agent of two common carriers for domestic certificates. The Department is concerned with the question of monopoly arising through control of one form of transportation by another. The interventions are aimed at the Grace Line, United Fruit Co., and Moore-McCormack Lines; and at Eagle Air Lines, subsidiary of Missouri Pacific Railroad and Automobile Air Freight Co. of Detroit.

United Fruit, asking for three routes southward from New Orleans, claims it cannot furnish complete, integrated service without an aviation auxiliary. Grace will attempt to show that Section 408 does not prohibit it from operating planes. Pan American will take its usual stand in favor of Section 408, as will many other air operators.

Grace is only one of 21 applicants before CAB for services from the U. S. to Mexico, Central, and South America. The Board recently held consolidated hearings on the area and is making a study of its own.

American Export, already operating between New York and Ireland, has asked for routes from New York to Natal and South Africa and from Natal to Bombay by way of Dakar, Rome, and Cairo.

Scores of applications have been filed recently for extensions of routes, new stops, taxi services, household moving, express, freight, and helicopter services. There are two more helicopter pleas from department stores which want to deliver packages in large surrounding areas.

Among other recent applicants are:

Blue Line Bus Co.: Springfield, Mass., to Westerly, R. I.

Blue Ridge Bus Lines: Routes, generally duplicating present ground service, from Cleveland, Pittsburgh, and Clarksburg, W. Va., to Harrisburg, Winchester, Va., and Baltimore.

Braniff Airways: Laredo, Tex., to Mexico, D. F. with intermediate stop at Monterrey, Nuevo Leon, an increase of 584 route miles.

Chicago & Southern: Memphis to New York via Chattanooga, Richmond, and Washington.

Delta Air Lines: New Orleans to Havana.

Gilbertville Trucking Co.: Cargo service from Ware, Mass., to Washington, St. Louis, and Chicago.

Dave Jolly, Memphis; Aerial taxi service.

National Airlines: Jacksonville, Fla., to Kansas City; mail and passenger service to Mexico and South America.

Pennsylvania-Central: 8,000 mi. from Miami and New Orleans through Caribbean, Central and South America; extension from Buffalo to Ottawa.

Thalhimer Bros., Richmond dept. store: 12 helicopter delivery routes.

United Air Lines: Cleveland to Ottawa and Montreal; Cleveland to New York; Chicago to Des Moines, Toledo, Milwaukee, and Moline, Ill.; four additional New York-Chicago stops. Total: 22 new cities and 2,050 route miles.

Continental has started Denver-Kansas City service with an additional Lockheed *Lodestar* returned after 18 months with the Army. Direct connection between U. S. and Mexico has been made possible by decision of CAB to allow planes of both Compania Mexicana de Aviacion and Braniff to operate from Nuevo Laredo airport.

Ford Plans Transport

"We have been experimenting with small models and engines," Henry Ford reveals in announcing that he plans to build at Willow Run after the war what his company calls "huge, multiple-engine, cargo-passenger planes of unique design."

Ford has also been permitted to announce that during the past year more than 1,000 B-24's were flown from Willow Run.

Five-Point Air Policy Offered by Airline Leaders

Policies for peacetime air transport were detailed at a recent dinner meeting of the Sales Executives Club of New York. Topic considered was "The Airlines—and Tomorrow," and the speakers were representatives of the 16 domestic airlines which have signed a declaration for the competitive, rather than "single instrument," approach to world-wide aviation.

Policies urged were: 1. World-wide free competition reasonably regulated by appropriate government agencies; 2. Private ownership and management to maintain business initiative; 3. Fostering by the United States government of a sound world-wide air transport system; 4. World-wide freedom of transit in peaceful flight; and 5. Acquisition of civil and commercial outlets required in the public interest.

The five policies were analyzed and discussed, respectively, by Pres. A. N. Kemp of American Airlines, Vice-pres. Paul H. Brattain of Eastern Air Lines, Pres. Jack Frye of TWA, Pres. S. J. Solomon of Northeast Airlines, and Vice-Pres. of Operations J. H. Carmichael of PCA.

Operators Outline Features Wanted in Postwar Planes

Washington (AVIATION Bureau)—Four airliners have been proposed in rough outline by the Air Transport Assn's. Aircraft Requirements Committee and by Air Cargo, Inc., an agency of the airlines. They are called A-1, B-1, C-1, and D-1 and their purpose is to help manufacturers design as nearly as possible the kind of planes the lines think they want.

But the proposals are not specifications. Any manufacturer can submit a design of his own craft—and perhaps sell it.

The outline of A-1 has been completed and released. It is a general utility plane for short haul—100 mi. Answers to questionnaires on B-1, a 50-60-passenger ship for 300-mi. runs, have been received and analyzed, and the proposals are being released. C-1 and D-1, for ranges of 500-1000 mi. and 1000-2000 mi. respectively are in process of study; questionnaires are in operators' hands.

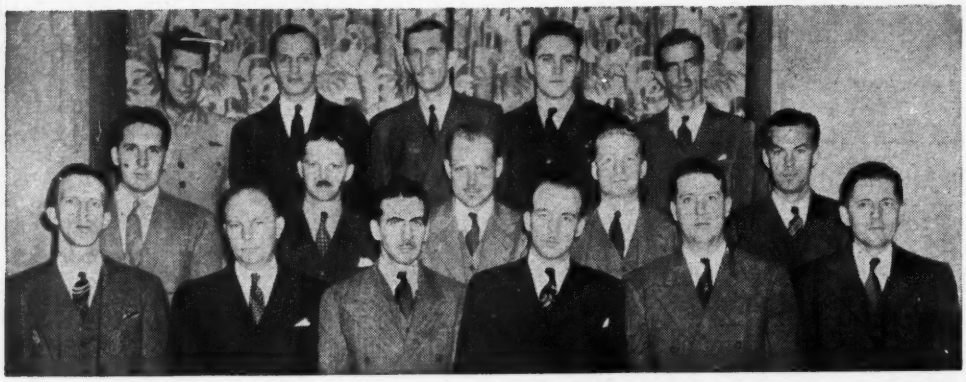
Following the Committee's suggestions, different manufacturers might obviously produce planes which would look differently, yet perform similarly.

The Committee hopes to come to conclusions soon on type C-1, but it will take a few weeks to issue a detailed report. Committee meetings are planned for every month or so. The present program is supposed to be completed this spring, but study of designs will be continuous.

No specific suggestions have been formulated on number of engines for these planes. Also, there is a difference of opinion among operators on high or low wings. Low ones are safer for emergency wheel-less landings and require simpler retraction apparatus, but passengers complain that they obstruct their vision.

UAL ROLLS 'EM ON

Packages on United's new New York-San Francisco cargo service are rolled on board specially adapted DC-3's over light magnesium gravity roller conveyor of 6,000-lb. capacity devised by Railway Express Agency.



DISCUSS AVIGATOR "TICKET" STANDARDS

Proposals for standard license requirements were considered at recent New York meeting of avigators of lines operating overseas and representatives of avigation associations. Bottom (left to right): J. M. Robinson, PAA; W. A. Bey, TWA; C. H. McIntosh, American; H. C. Thomasson, American Export; R. H. Ellenberger, PAA; and J. H. Blackburn, TWA and president of Airline Navigators Assn. Middle row (l. to r.): J. W. Kroupa, PAA; W. L. Danielson, Am. Export; K. Coughlin, Consairway Div., Convair; E. T. Bolton, TWA; J. R. Voeth, Consairway Div. Top (l. to r.): J. W. Robertson, PAA Navigators Assn.; F. T. Reese, American and President Avigators' Assn.; P. H. Redpath, TWA; R. D. Fraser, American; and A. D. Lapine, Eastern. Through the action initiated, new uniformity is expected.

0.3 Mills on Western's Mail

Western Airlines' mail rate from Jan. 1 last year on airport-to-airport mileage has been set at 0.3 mills per lb./mi. by CAB.

At present passenger and express rates, the Board estimated, this would provide an annual profit of $51,915. Fixing mail pay, it was announced "does not require the allowance in the mail rate of amounts heretofore frequently necessary in mail rate cases to permit the carrier to cover deficiencies" in commercial revenues.

PAA Records, Services

Pan American announces: Miles flown in the past year have nearly doubled, and crews have made more than 5,000 transocean flights since Pearl Harbor; the *China Clipper*, which hopped the Pacific 500 times between 1935 and Dec. 7, 1941, is now in its ninth year of service; new services have been established—daily from Seattle to Fairbanks, Alaska; two additional daily from Monterrey, Nuevo Leon, to Mexico City by Mexican affiliate, Mexicana de Aviacion: expansion of Panagra schedules provides three weekly flights across Bolivia, eight weekly between Lima and Buenos Aires, and five weekly between Lima and Santiago.

Radio Monitors Delivered

Islip Radio Mfg. Corp. announces delivery to CAA of two new automatic monitoring devices for indicating discrepancies in radio avigating systems.

One, an automatic range monitor initially installed at Salt Lake City and now undergoing service tests, indicates, by a red light and siren at the airport, any directional deviations of A-N signals and loss of transmitting strength. The other device gives similar warnings if radio course fan markers lose radiation strength or send out faulty signals.

Access and Egress

CAB has under consideration proposed amendments to Section 04.461, effective immediately, providing that all closed-cabin passenger aircraft shall have a door which may be opened either from inside or outside by a single handle with latched and unlatched positions plainly marked.

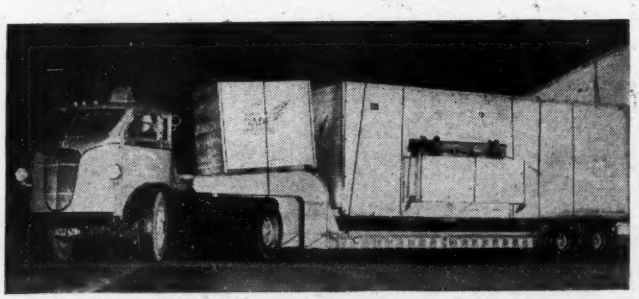
Training Institute Closing

Airlines War Training Institute, created early in the war to give "post graduate" flight instruction to members of the Air Transport Command, has been partially discontinued by the Army, announces S. J. Solomon, president of AWTI. Schools started after Dec. 1, 1942, upon request of Maj. Gen. Harold L. George, ATC commander, are closed. The 19 airlines had provided more than 100 in all.

ATC now has enough instructor personnel to carry on its own training program. AWTI has been recognized as highly successful and was one of many ways in which the airlines served as the nucleus of military transport services.

EAIA and KLM Permits

Temporary permits were recently extended for another three months to two foreign airlines operating into Florida as war-effort auxiliaries—Expreso Aereo Inter-Americano and Dutch KLM. Permits of three other lines (BWIA, TACA, and Compania Nacional Cubana de Avicion) lapsed because they did not get into operation, presumably for lack of equipment. Expreso is running with one Sikorsky S-38 and two tri-engined Fords, while KLM is flying three Lockheed 14's. The suspended three can apply for reinstatement and would undoubtedly receive permits.



TRUCK-TRAILERS SPEED PLANES

"Wrapping" service for fighters, medium bombers, and reconnaisance planes is provided by Dade Bros., Mineola, N. Y. Company boxes planes in crates, sometimes 40 ft. wide and 18 long, and hauls them to wharfs on huge truck-trailers.

New Transport Research

Postwar air transport research has been undertaken by the Minnesota Council and Twin Cities Chapter of National Aeronautic Assn. with assignment of study projects to its cargo and passenger subcommittees. Direction of these activities will be under Charles D. Pyle, according to announcement by Lowell H Swenson, president of Minnesota Council.

CROSS COUNTRY

Airports: Mayor La Guardia's plan to accept bids from oil companies for the fuel concession at New York's Idlewild Airport, under construction alongside Jamaica Bay in Queens, has been called "premature" by Ralph S. Damon, vice-president of American Airlines. Speaking for his own and six other companies now operating from La Guardia Field, Damon called the city's proposal to obtain an annual $3,750,000 from fuel sales at Idlewild a tariff on the lines. Its imposition, he warned, would be a "major" obstacle" in leasing arrangements with operators and might require re-examination of "our entire future service pattern for this area." . . . War Dept. has authorized construction of a $150,000 hangar with a 3,000-ft. parking apron at Logan International Airport, East Boston. . . . Wichita's city planning commission has approved idea of a 15-acre helicopter landing field near center of town and a combination air-bus terminal right in the middle of things. Execution is dated in "the future."

Scottish Aviation's Group Capt. D. F. McIntyre predicts $200 U. S.-Britain round trips shortly after the war. Using bases in Iceland and Greenland and bigger planes than today's, he estimates, will knock the price in half.

Seven more transports have been returned by the Army. This makes 20 altogether since June. Two each went to American, Eastern, and United, one to TWA.

Since Harriman, Ripley & Co. will handle United's contemplated financing, Joseph P. Ripley has resigned his UAL directorship as prescribed by Civil Aeronautics Act.

American is circulating a public questionnaire for the benefit of its designers: Just what do you like about plane accommodations and what annoys you?

Maryland has set up offices in Baltimore for i · State Aviation Commission, directed by Maj. Paul V. Burwell, Air Corps Reserve. The Commission: Dr. Hugh H. Young, chairman: Edgar Allen Poe, Jr.; Thelma Elliott; Comdr. J. E. Leeper, USN; and Wm. K. Ebel.

Return of many flyers from the war will not make pilots worth "a dime-a-dozen" predicts UAL's Pres. W. A. Patterson. For "the pilot is a professional man. The law of supply and demand does not determine the compensation paid for professional services."

Douglas has consulted the register of the famous who have gone by *Skymaster*. Among them: Pres. Roosevelt, Cordell Hull, Frank Knox, Winston Churchill, Joseph E. Davies, and Wendell Willkie.

Tactics vs. Rocket Shells

The high losses suffered some time ago by the USAAF during its raid on Schweinfurt were largely caused by German fighters, mainly FW-190's, carrying rocket shells.

German tactics had been to fire the rocket shells into our close *Fortress* formations from a point just outside the range of our .50 cal. guns. The Nazis had initial success due to the element of surprise, but since then losses have dropped considerably as we developed defensive tactics.

It is reported that the discharge and trajectory of the rocket shells can clearly be seen and that a slight change in our formation's course and altitude results in complete misses. Further, the shells are fired from ponderous underwing launchers which cut the speed and maneuverability of the Nazi fighters, "setting them up" for destruction by our escort fighters.

French Developments

Word comes through that the French aviation industry is not only building German planes and engines but is also continuing development and construction of some original French designs where they fit in with German plans.

Most important is the fact that the three six-engined flying boats, completed some time ago, are now flying for the Lufthansa, an attempt to get them to Swiss territory having failed. These planes, the Potez SCAN 161, Sud-Est 200, and Latecoere 631, were fairly successful, and several additional models of the latter two are reported under construction.

Only new type plane reported is the craft made by Mauboussin, a company which has mainly concentrated on sport planes. Known as the M-400, this twin-engined machine is said to be a "deadringer" for the de Havilland *Rapide*, even though the engines are pushers with some 350 hp. Designed for freight, it has a 13,000-lb. gross weight and 210 mph. top speed.

Reported in production is the Bloch 161, a 19-ton four-engined plane for 20 to 33 passengers, of which 25 have been built for the DLH (Lufthansa) and an additional 200 are reported on order.

Other factories are building parts for BMW and DB engines, together with French designs such as the Gnome Rhone, which the Nazis are using extensively. Arado and Buckmann trainers also are being built.

Quite a few four-engined planes are said to be under development, but their actual construction is still somewhat problematic, unless they fill a specific German need.

INTERNATIONAL BRIEFS

BOAC, which lost most of its Short flying boats to the government during the first years of the war, is now getting a number of the converted **Pegasus**-powered **Sunderlands**.

Performance is reported "better than ever" on a new **Spitfire** in general use on the Italian battlefronts. Featuring sharply pointed wingtips, it mounts the **Merlin 61** engine and employs a four-bladed prop.

More data on the Me-410, which superseded the 210 and 110: Equipped with two Daimler Benz 18-cyl. engines of 1,800 hp. at 20,000 ft., it is reported to have a 390 mph. top speed and 1,000 mi. range. Armament has not been changed, though armoring has been improved.

A new fighter under development in Sweden follows the asymmetrical design experimented with in Germany. A separate nacelle carries two Napier Sabre engines with contra-rotating propellers, and the pilot has a prone position in a pencil-like fuselage. Top speed is put at 478 mph., gross weight at 20,000 lb.

On Schedule . . . by "Vista"

Reports about the Belgian Sabena airline have been scarce since the war disrupted its connections with Leopoldville in the Belgian Congo. But with the general situation improved, Sabena is again planning service, intending to fly from England to the Congo with Lockheed *Lodestars*. The company will probably also use the DC-3's and Savoia-Marchetti 73's it has in the Congo.

New managing director of KLM Royal Dutch Airlines is H. Nieuwenhuijs, who recently passed through New York on his way to Curacao to inspect company lines in that part of the world. For many years connected with KNILM, of which he was co-director with KLM's Plesman, he is expected to straighten out the KLM-KNILM tangle. KLM still suffers from a shortage of aircraft, having only two Lockheed 14's actively available, together with two 1932 vintage Fokker 18's. A third Lockheed awaits repair parts. Two *Lodestars* turned over to the Curacao government under Lend-Lease for government flights, are operated and maintained by the KLM. Attempts are being made to get these planes released for passenger use by KLM.

Spain's nationalized airline, the Iberia, recently resumed Madrid-Barcelona services after a half year suspension due to a gas shortage. The re-opening is felt to be a result of negotiations between Spain and the United Nations, particularly Britain and America, to obtain gas and spare parts. As reported some time ago, the Spanish government purchased full control of the Iberia from German interests.

Another British shipping line, Donaldson Lines, Ltd., has received court permission to amend its charter to allow operation of air transport services on a worldwide basis.

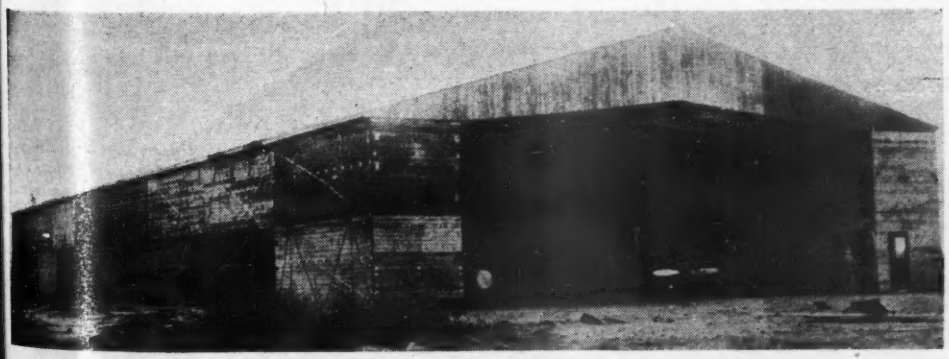
A new PAA satellite has started operations in Venezuela, running unscheduled all-cargo routes into the interior. Known as Avensa (Aerovias Venezolanes S. A.), the line is managed by Carl Yaggy, formerly in Panam's western operations department.

British planes are now using long-range fuel tanks made of a special paper which is bonded with animal glues and impregnated with a gelatin. Production is reported to be both fast and cheap.

Australia's Civil Aviation Department is studying plans for development of extensive aerial networks on the Australian continent. Feeder stations are called for every 150-300 mi. One plane being considered for use on the long hauls is the Avro **York**.

BWIA Trinidad-Miami flights were reported in this column in November. This was in error, since regular services were never actually started. Lack of equipment is cited.

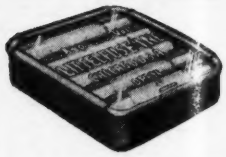
Its imports now virtually nonexistent. Sweden is projecting an aircraft-engine industry of its own. It is stated that the new Mannerstedt plant (6-row, 42-cyl., 2,500 hp.) will power a new fighter. Features of this engine are inter-coupled overhead camshafts for the six rows of cylinders, a two-speed two-stage supercharger with intercooler, and an innovation in shaft-to-prop design.



CRATE-BUILT ASSEMBLY HANGAR

Seems there's no limit to what field men can do with old aircraft shipping crates. Using 60 of them, RAF service unit constructed this spacious assembly hangar in India's Sind Desert, where wood is at a premium. Workshops and bungalows were other structures they conjured out of crate-wood. (British Combine photo.)

Protect Irreplaceable Equipment by NEW FUSING

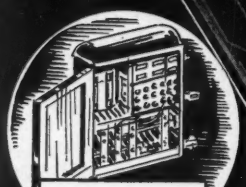


An Instrument Littelfuse (actual size) showing "Locked Cap" assembly and Bridge Construction.

"How soon can we get ——? "

X-Ray Inspection.

Radio and electrical testing equipment.



Rectifiers.

Switches.

Relays, Magnets.

FUSE EVERY INSTRUMENT FOR SAFETY WITH *Littelfuses*

This is a war of electrical instruments—for metering, testing, inspection, protection—absolutely necessary to production. Such equipment must work dependably and constantly. High speed production has brought about an acute problem. These instruments are in danger of overwork. Many are irreplaceable. Critical materials used in their construction are required for a multitude of other essential purposes. Jewels used in instruments are difficult to obtain.

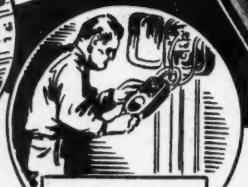
Present Equipment Must Be Kept on the Job!

Efficient fusing prevents damage by short circuits—burnouts—saves valuable instruments—protects them against inexperienced operators. So important is fusing that many plants and laboratories are making complete surveys of their equipment, and installing new fuses throughout. Littelfuse will be glad to help you with practicable suggestions on fusing instruments and other equipment. Feel free to call on us.

Plant signaling and communications.

Milliammeters.

Wattmeters.



Ammeters.

Voltmeters.

Panels and switchboards.

Littelfuses are especially d signed for protection of instrument equipment i cluding the most delica

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Aviation Finance

United Air Lines plans a 200,000 share issue of preferred stock, of which 105,032 will be presently issued, as a step in providing the $20,000,000 in working capital which Pres. W. A. Patterson has said would be needed within the next few years. Authorization also was sought from stockholders for 100,000 shares of management stock and an increase of from 2,000,000 to 2,500,000 shares in the common stock. Around 25,000 shareholders hold the 1,500,450 common shares now outstanding. The new preferred will carry a 4.5 percent dividend rate.

United Aircraft Corp. reports profits of $3,861,410 for the quarter ended Sept. 30, or $1.38 a common share against $3,460,932 or $1.18 a share in the like '42 period. Nine month's earnings were $11,-982,323 or $4.14 a share against $10,415,920 or $3.55 a share a year earlier.

Loans: Lockheed Aircraft Corp. has expanded its line of credit with 15 banks from $60,000,000 to $105,000,000. The proportion of the principal amount of loans guaranteed by the government is increased from 65 percent to 90 percent.

Curtiss-Wright Corp. declared a dividend of 75c. payable Dec. 23. This 1943 disbursement compared with one of $1 a share in 1942. Wright Aeronautical Corp, a subsidiary, voted a $7 dividend against one of $8 a share the previous year.

Thompson Products reported earnings of $2,018,912 or $6.43 a share for the nine months ended Sept. 30 against $1,959,-305 or $6.29 a share in the like '42 period. Sales were $97,338,-108 against $59,034,155. The aircraft division accounted for $38,699,256 of sales in the 1943 period.

Fairchild Engine & Airplane Corp. directors voted company's first dividend on Nov. 18 when a payment of 20c. a share was declared. Pres. J. Carlton Ward, Jr., stated that "careful consideration has been given by the directors to the conservation of cash for expanding war production and to meet the uncertainties of postwar financial requirements and for the conversion of facilities."

Northeast Airlines has purchased the assets of Mayflower Airlines, Inc., subject to CAA approval. At the same time the Boston & Maine R.R. and the Maine Central R.R. have each sold 20,000 shares of their NEA holdings, reducing their interests in the airline from 15 to 11 percent each. It is understood they plan to dispose of additional stock. Atlas Corp, an investment trust, is reported to have purchased the NEA stock sold by the rails.

December Dividends: Glenn L. Martin Co. declared a $1.50 common dividend in December, making $3 a share for the year against $1.50 in '42. Grumman Aircraft Engineering Co. paid 50c. on the common, making $1.50 for the year, same as in '42. American Airlines dispensed $1.50 a common share as it did the previous year. National Aviation Corp., with a 50c. dividend, brought 1943 payments to 75c. on the capital stock against 62½c. a share in '42.

Northrop Aircraft paid its first dividend to stockholders on Dec. 10 when a payment of 40c. per share was put in the mails. Northrop stock was first offered to the public in the summer of 1939 at $6 a share.

Northwest Airlines stockholders have approved an increase in the authorized capital stock from 300,000 shares to 600,000 shares. The increase in capital is intended to finance the expansion and postwar plans of the line. Earnings for the year ended June 30, 1943, were $614,301 or $2.61 a share against $430,100 or $1.83 a share the previous year.

More Dividends: Aviation Corp. declared a 10c. dividend, bringing payments for 1943 to 20c. against 25c. in '42, while Interstate Aircraft & Engineering paid 25c. and Continental Motors Corp. made a 15c. a share payment late in December. Pan American Airways paid a $1 dividend, same as in '42, while Sperry Corp. voted a 75c. payment to bring the year's total to $1.50 as in 1942. Roosevelt Field made a 25c. payment as it did the previous year, and Piper Aircraft paid its regular quarterly 15c. preferred dividend on Dec. 1.

Braniff Airways has adopted a policy of paying "modest" quarterly dividends, one of the first airlines to do so, and it also plans extra dividends when earnings justify, according to Pres. T. E. Braniff. A 15c. payment was made in November. Profits for the Sept. quarter were $305,543 or 30c. a share against $191,993 or 19c. a share in the like '42 period.

Pan American Airways has obtained a minority interest in a new South American all-cargo line, Aerovias Venezolanes, S. A., to operate on a charter basis in Venezuela. Panair do Brasil, S. A., a Pan American subsidiary, plans to sell a 40 percent stock interest to Brazilian nationals.

Continental Air Lines had a net income of $280,819 or $1.12 a share in the fiscal year ended June 30, 1943 against earnings of 22c. a share the previous year. Increasing cost of operations and other uncertainties makes difficult any accurate forecast of operating results in the immediate future, according to Vice-Pres. Terrell C. Drinkwater.

Bell Aircraft directors have authorized a 1943 year-end dividend of one share for each ten held. A dividend of $1 a share was paid in June, while stockholders received one dividend of $2 a share in 1942. Breeze Corp. made a 40c. payment on Dec. 10, bringing 1943 disbursements to $1.60 a share. Meanwhile, Bell is returning $8,900,000 to the government through renegotiation of '42 earnings. After taxes, the net effect on '42 earnings is only $1,163,180, an amount which was more than covered by the reserve for contingencies. Actually, the renegotiations were charged against earned surplus.

Luscombe Airplane Corp. has arranged a $500,000 V-loan and at the same time has paid off the balance of its $1,000,000 RFC loan arranged in May 1942. The new loan is guaranteed by the Navy Dept.

By RAYMOND L. HOADLEY

Difficulties of predictions . . . What two-billion lop in air program may mean . . . Those stock lows of '43 . . . Surplus inventories "like lifting the old mortgage."

HOW WILL THE AIRCRAFT COMPANIES fare in 1944? Frankly, it's the most difficult year to forecast since the writer began covering aviation back in 1924. Much will depend, of course, on how soon things quiet down in Europe and the progress made in the Pacific. But it seems clear that some peacetime reconversion will take place this year, even in the aircraft industry, although it may not be along the generally expected lines.

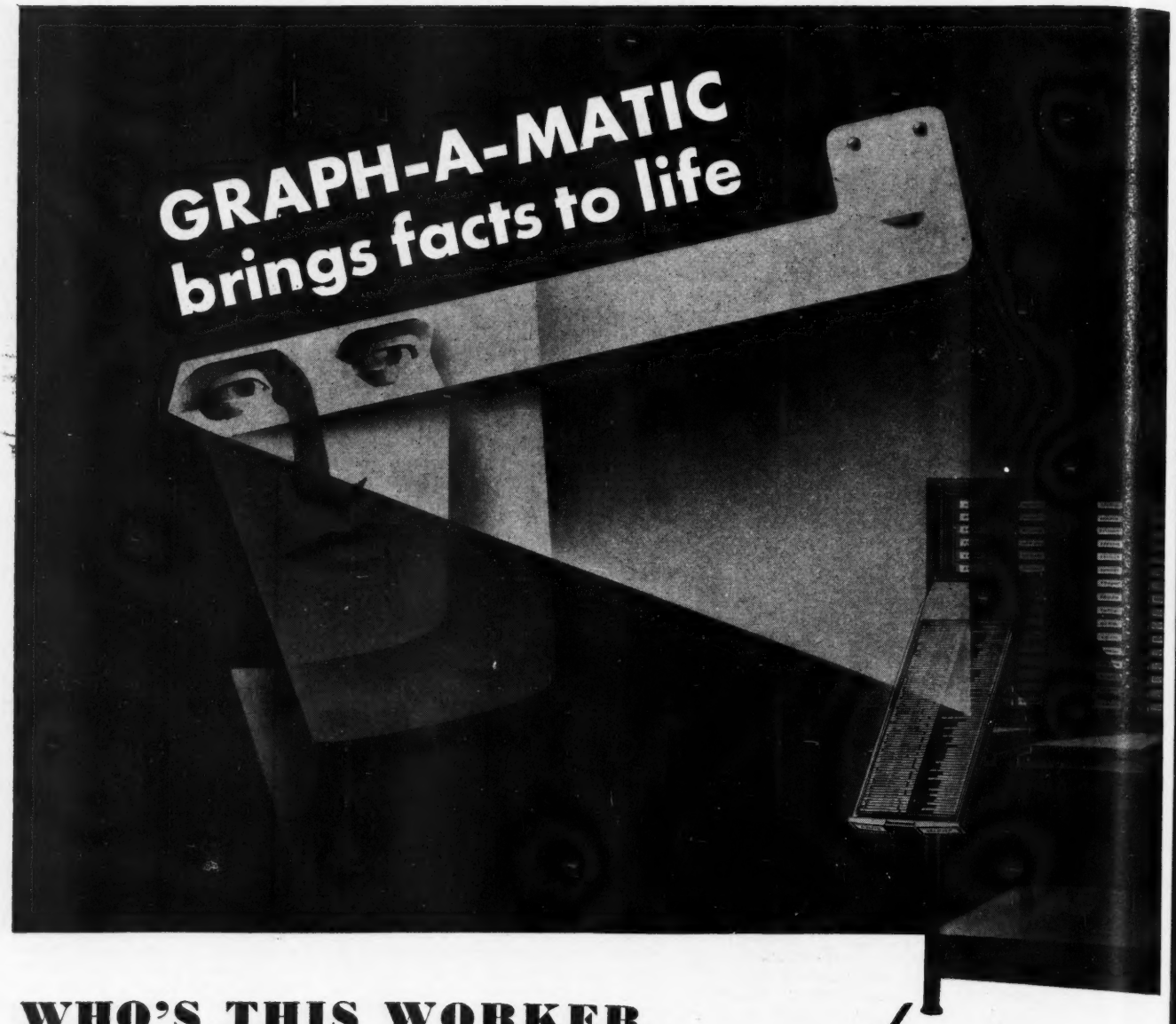
The War Department, it is already known, plans the modification and possible permanent deferment of part of its aircraft program to the tune of $2,000,000,000. That, and other pending changes in the over-all picture, may mean that some segments of the industry will be converted to the manufacture of light civilian goods—products far removed from the assembly of warplanes. Fact is that civilian-requirements officials in Washington are considering just such a revolutionary change for the plane plants that will not be needed in war production. And if aircraft makers are temporarily switched to the output of other goods it may be some time before stockholders can be appraised of the profit possibilities on the civilian lines.

Outstanding air transport problem to be solved this year will be international air policy. Airline investors should keep their eyes peeled for a policy parley between Washington, London, and Ottawa officials shortly. Great Britain and her dominions already have made plans to get their overseas aviation rolling as soon as Germany is defeated. And Canadians, returning from the recent London air conference, understand that a three-nation parley is on the agenda.

The way aircraft stocks were dropping to new lows towards the close of '43, one would think that they never had, nor ever would, net any dividend return to their stockholders. In most instances, however, 1943 year-end dividends were as large as in the previous year. Aggregate payments by the entire industry lagged somewhat behind 1942, due largely to the reduced amount paid by Curtiss-Wright Corp. on its large common capitalization.

Trade officials anticipate that more transport planes will be transferred back to the domestic airlines by the government early this year. That will mean new traffic records. But because of excess profits taxes it will not necessarily mean larger earnings for the major lines.

Record high inventories present the plane makers with a potentially serious problem as demobilization draws closer to the industry. Much of this in entory is unsuited for commercial production. Furthermore, it is doubtful if the government will recognize some of this excess upon termination. Getting rid of excess parts and raw materials these days is like lifting the mortgage from the old homestead.



WHO'S THIS WORKER offering you *balanced* production?

Industry today faces the urgent need of preparing for contract renegotiation or termination . . . of establishing inventory accountability in accordance with authorized production schedules . . . of avoiding potentially useless inventories of raw materials and work in process.

All these add new emphasis to the importance of setting up administrative control systems designed to produce *facts* from which management can operate intelligently.

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WE INVITE YOU to inspect the methods of administrative control now used by the management of 136 of the nation's foremost businesses. These are illustrated in the new 74-page brochure "Graph-A-Matic Management Control". Due to the nature of its contents and the many months of careful preparation entailed, we can offer this brochure only to responsible executives.

A wire, letter or phone call to our nearest Branch Office will bring "Graph-A-Matic Management Control" to your desk. One of our Systems and Methods Technicians whose work it represents will gladly discuss the application of these methods to your business.

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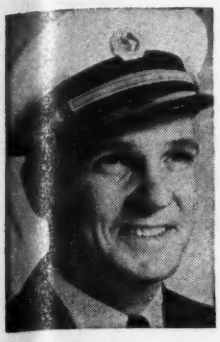
Aviation People



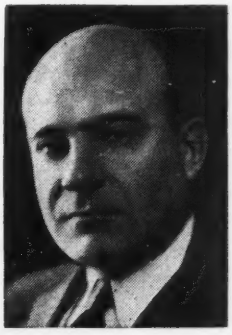
CAPT. HAAKON G. GULBRANSEN, PAA master of ocean flying boats on transatlantic routes, recently marked 10th anniversary of his flying activities. He served his pilot apprenticeship with PAA flying Caribbean routes, later transferred to Pacific and South American runs. (PAA photo.)

M. J. SMITH, comptroller of the Curtiss-Wright Propeller Div., Indiana plant, has transferred to Caldwell, N. J., as comptroller of the entire propeller division. He succeeds GEORGE M. EBERT (right) who has been named director of finance for the airplane division of the corporation, and will headquarter in Buffalo. Prior to joining C-W last year, Smith was treasurer of the Packard Mfg. Corp. Ebert has been with C-W for the past 14 yr., and before being named comptroller of the propeller division last year was chief accountant, treasurer, and asst. treasurer of the corporation and comptroller of the warplane plant.

EDWARD W. PLACE was appointed assistant to the eastern regional traffic manager of Transcontinental & Western Air, Inc., and will be on the staff of Lee Swigart, recently named eastern regional traffic manager. Before joining TWA, Place was with Wall Street firms. (TWA photo.)

BRIG. GEN. THOMAS B WILSON, TWA board chairman now on leave as Chief of Transportation, Allied Forces, Southwest Pacific, personally received medal of Legion of Merit from Gen. MacArthur. Citation was "for exceptionally meritorious services in Pacific." (TWA photo.)

A. W. COLEMAN has been appointed to the newly created position of director of industrial relations of the Harvey Machine Co. He is chairman of the labor relations committee and permanent chairman of the personnel managers group of the APMA.



CARL T. DOMAN has recently been advanced to the post of first vice-president of Aircooled Motors Corp., and he also continues as engineering head of the organization. Meanwhile, C. F. B. ROTH (right) has become vice-president in charge of the company's sales. Doman, who was one of the founders of the corporation, is widely known in aviation and automotive circles, while Roth has been general sales manager for the last five years and has been connected with various phases of the aviation industry since 1927.

DR. SANFORD A. MOSS has been awarded Sylvanus Albert Reed Award for 1943 "for development of the turbosupercharger, making possible the high altitude operation of aircraft". Presentation was at Honors Night Dinner of Institute of Aeronautical Sciences.

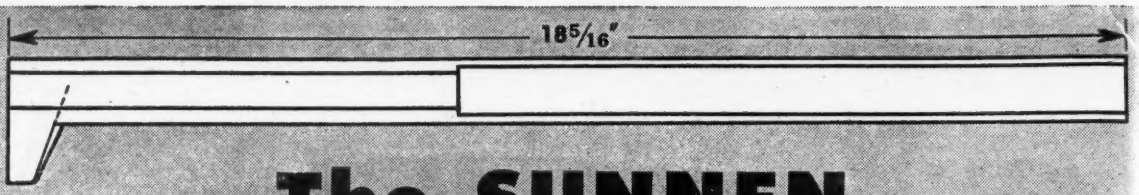
RICHARD C. LONG, regional director of PAA for the United Kingdom, Eire and Portugal, lauded on completing 10 yr. of PAA service. Long, whose headquarters are in London, earlier served 10 yr. as a trade commissioner and attache D. of C. (PAA photo.)

WILLIAM TAYLOR has been elected president of Lineas Aereas Mineras, S.A. of Mexico, according to an announcement made by United Air Lines Pres. W. A. Patterson. UAL recently acquired a controlling interest in the line, which operates passenger-mail-express flights through central Mexico. (UAL photo.)

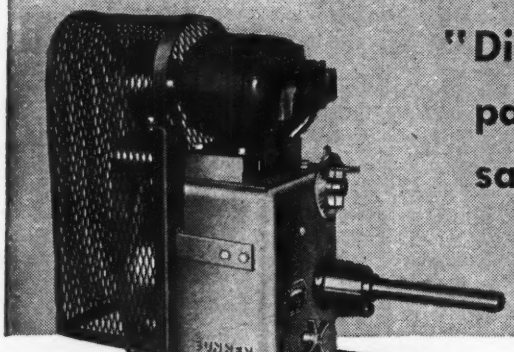
J. R. GOLDSTEIN, former Douglas engineering laboratory chief, will head the company's newly formed research laboratories under a five-power program board. Goldstein, who has been associated with Douglas engineering research since 1934, will steer the activities of more than 500 engineers and technicians.

HENRY GEORGE HOWELL has been named as a member of Chicago & Southern's research and planning staff. To act as a consultant in planning postwar routes in Mexico, he has ample experience in the operation of Mexican airlines, since he formerly was copilot with Serviceo Aereo Panini. (C. & S. photo.)

MICHAEL E. GLUHAREFF has been appointed chief engineer and SERGE E. GLUHAREFF (right) assistant engineering manager of Sikorsky Aircraft Div., United Aircraft Corp. Michael Gluhareff will be responsible for the design and development of all helicopter projects, while his brother will direct and administer the organization and functions of the experimental engineering department. Both will conduct their work under the general direction of Engineering Manager Igor I. Sikorsky, with whom they have been associated for 19 yr. Born in Russia, the brothers got their initial experience building gliders in Finland following World War I. (P & W photos.)



The SUNNEN PRECISION HONING MACHINE



"Did such a fine job of honing it will pay for itself many times over in the saving of scrap parts and time" . . .

Mr. A. G. Massey, Massey Machine Company

The coveted Army-Navy "E" waves over the Sunnen plant —evidence of the important part Sunnen Equipment is playing in the war effort.

The drawing shown above is of a steel part from a 20 MM aircraft gun. By former methods of honing, too many of these parts were being rejected because they were being cut oversize with no means of salvaging them.

A consultation with a Sunnen Service Engineer led to the installation of the Sunnen Precision Honing Machine to handle these finishing operations. In the manufacturer's own words — "This machine is going to pay for itself many times over in a short while in saving of scrap parts and time." In addition, he is getting a better surface finish.

Consider These Advantages

Wide range — handles internal diameters of .185" to 2.625". Accuracy within "one-tenth" guaranteed — has been held to .000025" on production jobs. Relieves big internal grinders for other jobs. Corrects errors of out-of-roundness or taper caused by previous operations. Facilitates duplication of sizes. Does not require skilled labor. Practical — inexpensive — economical to operate.

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Typical Jobs

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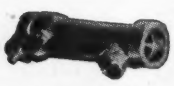
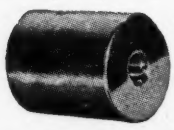
Aircraft Instrument Panel Control Wire Bushing. Hole .187" diameter — held to .0002", stock removal .001", sixty per hour.



Aircraft Hydraulic Brake Cylinder. Honing 3 times faster than lapping—and gave a straighter hole.

Roller Bearing Outer Race. Finish improved from 12 micro-inches to 2 micro-inches.



Header Die. Life of header dies increased 3 to 9 times over lapping. Knock out pin breakage practically eliminated.

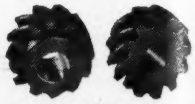
Aircraft Valve Tappet Roller. Honed after grinding to give 100% bearing surface.

Stainless Steel Load Compensator Valve Seat. Hole is honed to .0002" limit.

Aircraft Carbureter Operating Valve Sleeve. Sunnen honing eliminates distortion from assembling operation.

Aircraft Piston Pin. Sunnen honing is twice as fast and gives a cleaner, better looking pin.

Bearing. A very small part. 2 micro-inch finish necessary.



Automobile Distributor Shaft Gears. Taper removed at a rate of 80-90 per hour.

Recent Books

• *AEROPLANE PRODUCTION YEAR BOOK AND MANUAL, edited by G. W. Williamson. Paul Elek, London.* 564 *pages, index,* $8.30.

Collection of some 65 technical articles, predominately British, plus a list of other titles and abstracts from journals, on production fundamentals and methods and on aircraft equipment. British manufacturers, it appears from an article by G. Geoffrey Smith, managing editor of *Aircraft Production,* also suffer from the same political uncertainties as Americans, for "just as they cannot complete the design of a suitable air transport until operators define their requirements, so operators are prevented from formulating their plans until government air policy has been clearly defined and studied."

• *TUNGSTEN, by K. C. Li and Chung Yu Wang. American Chemical Society Monograph Series, Reinhold Publishing Corp., New York.* 325 *pages, appendix, illustrations, index,* $7.

Technical description of the war-valuable element for which the Germans are said to have recently paid $50,000 a ton. Detailed are its history, geology, ore dressing, metallurgy, chemistry, analysis, industrial applications, substitution, and the related economics.

• *SALVAGE MANUAL FOR INDUSTRY. War Production Board. Available from Superintendent of Documents, Washington.* 243 *pages, illustrations, index,* 50c.

Wealth of detailed facts for plant managers and engineers on exactly how to establish salvage programs and how to retrieve the most materials through their use. Prepared under the direction of a group of industrialists and business paper editors, who have also appended a list of hints on conserving various materials and types of equipment.

• *SYSTEMATIC WAGE ADMINISTRATION IN THE SOUTHERN CALIFORNIA AIRCRAFT INDUSTRY, by Robert D. Gray. Industrial Relations Counselors, New York.* 91 *pages, appendices, glossary,* $1.25.

Study, by a professor of economics at California Institute of Technology, of the uniform job classification and pay plan adopted in the spring of 1941 by Consolidated, Douglas, Lockheed, North American, Northrop, Vega, and Vultee. Two years later it was accepted by WLB as a basis for further wage adjustments. Success of this evaluating, pricing, and merit rating analysis, states Prof. Gray, was due to the active interest and cooperation of top management.

The conclusion is offered that "it appears unsafe for any organization to assume that it can operate effectively without a rational method of setting wage rates, and an orderly wage structure cannot be established and maintained except through use of systematic wage and salary administration."

• *BASIC PHYSICS FOR PILOTS AND FLIGHT CREWS, by E. J. Knapp. Prentice-Hall, New York.* 118 *pages, diagrams, index,* $1.65.

Simple resume of elementary principles designed to ready cadets for further study in aerodynamics, engines, and meteorology. Topics considered are units of measure, vectors, motion, fluids at rest, work, energy, power, friction, fluids in motion, heat, gases, change of state, and atmospheric humidity.

• *NAVIGATION PART I, by Lyman M. Kells, Willis F. Kern, and James R. Bland. McGraw-Hill Book Co., New York.* 288 *pages, appendices, index,* $2.50.

• *NAVIGATION, by J. C. Kingsland and D. W. Seager. Oxford University Press, New York.* 95 *pages, index,* $1.

• *AIRCRAFT NAVIGATION, by H. Stewart, A. Nichols, S. A. Walling, and J. C. Hill. The MacMillan Co., New York.* 146 *pages,* $2.

Kells et al. of the Naval Academy: Simple definitions of principles developed into demonstrations of their applications through generous use of illustrations, diagrams, and problems. This volume deals with fundamentals of mathematics, instruments, charts, piloting, and maneuvers; appendices cover logarithms, the range finder, and maps.

Kingsland and Seager: Descriptions (with exercises and diagrams) of the earth's form, maps and charts, magnetism and the compass meteorology, and dead reckoning "to help the intending air navigator with the initial stages of this training by placing before him the rudimentary principles of his art."

Stewart et al.: Two parts of this book—theory and practice—cover first maps, drift, bearing, wind direction, compass, altimeter, air-speed indicator, and meterology; and second the circular slide rule, fixes, radius of action, and radio bearings. "The aim has been to give a concise introduction to the subjects of which [avigators] must become masters before they can claim to be competent."

• *CHEMISTRY AND THE AEROPLANE, by Vernon J. Clancey. Ronald Press Co., New York.* 176 *pages, index,* $2.25.

Chemical descriptions and analyses of aviation materials—fuels, steels, plastics, etc. Neither a text on chemistry nor one on flying, but rather a synthesis about the interrelations between the two.

• *PRE-SERVICE COURSE IN MACHINE SCIENCE, by Samuel H. Lebowitz. John Wiley & Sons, New York.* 440 *pages, illustrations, index,* $2.50.

Conforming to official syllabi, this text presents chemical and physical principles involved in operation of various engines of war and war production.

• *FOREMANSHIP TRAINING, edited by Richard B. Starr. Prentice-Hall, New York.* 191 *pages, index,* $2.65.

Symposium based on conferences considering pressing problems which confront the foreman. Case studies and discussion questions are included to further orient the new man to his duties, problems, and responsibilities as management's direct representative.

• *PATENT LAW, by Chester H. Biesterfeld. John Wiley & Sons, New York.* 225 *pages, subject index, table of cases, bibliography, appendix,* $2.75.

For engineers and research workers, this book clearly presents the trend of patent precedents. They are outlined in various chapters—including novelty, priority of invention, re-issues, infringement, licenses, trade secrets, and litigation. Each principle, once defined, is further illustrated by citations from salient cases. Observing that "the courts have been holding invalid about 80 to 90 percent of the patents coming before them in recent years," the author points out that "basic patents and important patents covering new technical results will still be sustained, and to this extent the policy is not anti-monopolistic; but the lot of the mere improvement patent has grown hard."

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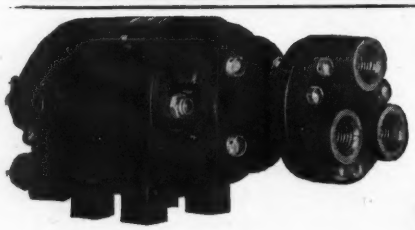

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for Propellers, Carburetors, Windshields and other Vital Parts

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Patents

By A. HARRY CROWELL
Registered Patent Lawyer

FOLLOWING are digests of some of the more interesting recent patents on aviation developments granted by the U. S. Patent Office. Mr. Crowell will gladly furnish readers with free information on approximate cost and procedure in applying for patents and trademark registration. Address inquiries to him, care AVIATION, 330 W. 42nd St., New York City (18). Printed copies of any of patents listed are obtainable at a cost of 10c. each, directly from U. S. Patent Office, Washington.

"Rocket-Type" Bomb, devised to propel itself to target faster than normal falling rate, incorporates rocket tubes in rear end of bomb case. Propelling combustible is detonated after falling bomb reaches certain velocity.—2,332,670, filed Dec. 1939, patented Oct. 26, 1943, W. F. Rous

Variable Pitch Airscrew. Invention is concerned with propellers of type in which a hydraulic ram is used to adjust blade pitch via actuation of a governor unit controlling supply of pressure fluid to ram. Means is provided for automatic setting of blades to suitable pitch in event pilot loses control of airscrew.—2,332,786, filed Feb. 17, 19 patented Oct. 26, 1943, L. G. Fairhurst and H. Newport, assignors to Rotol Airscrews Ltd.

Retractable Undercarriage patent calls for lateral retraction of wheels in such manner that they enter their housings edgewise rather than flat. Gear includes at least two folding systems, one causing wheel axle to pivot, other bringing wheel into housing "on tangent to pivoting circumference arc of gear."—2,332,844, filed Jul 11, 1939, patented Oct. 26, 1943, A. Muyser, vested in Alien Property Custodian.

Fuel Injection System for supercharged aircraft engines calls for electromagnetic control of injectors in manner to extend range of control. Device comprises positive connection between engine throttle and means for varying volume of fuel injected. It makes use simultaneously of two such fuel-varying means, with simultaneous cumulative action on all injectors of engine. Aim is change of fuel volume pumped to injectors per unit of time, independent of engine speed or of any variation in length of time of each injection.—2,332,9 filed Nov. 21, 1939, patented Oct. 26, 19 O. Fuscaldo, vested in Alien Property Custodian.

Storm Area Indicator. This unit is for installation on aircraft in order to detect presence of electrical storm conditions in vicinity of flight and to indicate location of storm area, in relation to aircraft, with ample time for pilot to avoid contact with it. Patent is for unit provided with pattern of sharp-pointed rods charged with just enough current to overcome ionic thresholds of points. Electrical field is then detected via points, intensity of field being measured by connecting meter in circuit with each point.—2,333,975, filed July 11, 1941, patented Nov. 9, 1943, W. Bennett, assignor to James Slayter.

Retractable Gear Component, applicable to main undercarriage, nose-wheel, tail-wheel or wheel-less alighting gear, consists of unit including landing element mounted by means, such as a leg, connected directly to a strut by a resiliently deformable frame. —2,333,981, filed Aug. 14, 1940, patented Nov. 9, 1943, D. G. Bridges, assignor to Dowty Equipment, Ltd.

Cargo Loading and Securing patent relates to method wherein combined use is made of roller conveyors and of cargo containers which have skids on bottom to facilitate movement on rollers. Skids are so placed with relation to space between rollers that when containers are turned at right angles

ids will rest on fixed rather than rolling rface.—2,334,124, filed Nov. 9, 1942, pat- ted Nov. 9, 1943, C. G. Peterson.

opulsion Differential for power plants of ulti-engine aircraft is aim of patent in- ded to achieve more efficient steering of rcraft when on ground. Stated to be mply operable, unit is designed to co- rdinate engines with operation of plane's ntrol surfaces.—2,334,504, filed Nov. 20, 40, patented Nov. 16, 1943, J. Perina, signor to Republic Aviation Corp.

coy Airplane, of kind employed in mili- y strategy to deceive enemy, comprises selage frame composed of connected rved elements. These elements in abut- g relation along top of body and spaced ng bottom, simulate top and opposite es of an airplane frame. Single piece is ountable on frame to cover all but open ttom.—2,334,539, filed July 30, 1942, pat- ted Nov. 16, 1943, C. E. Buchtel, asignor Monco, Inc.

"Master of Knack"

(*Continued from page* 215)

me in for a landing and the undercar- ge would give until it resembled a l with a case of rickets. This "dis- se" was grounding the fighting planes. a service man was flown to a remote ghter base to find and correct the ouble.

He crawled around the ships and uld see at a glance that the gear on ost of them was, sure enough, bent etty badly. But as far as he could ertain there was no defect in the aterial that would weaken the struts to ch an extent that they would become wlegged. Then he happened to wit- ss a landing—and after that the ystery of the bandy-legs was cleared .

The serviceman put it this way: "That ot came in like a bat from hell. He osed that P-40 in well above a 100, veled off—and then dropped her. He like a ton of brick, and I'll swear he unced 30 ft. in the air. After the rth bounce, some Gremlins came out d tied the runway to his wheels, I ess.

"I talked to him later. 'Whuthehell!' said, 'Sure, I bounced her. I like bounce. So do the other guys.' I plained to his CO that bouncing an plane on landing will do one of two ngs. It'll either wreck the ship and l the pilot, or it'll just wreck the ship. e CO got the point, and he quickly ve the boys a lecture. They stopped ncing, and that was the end of t."

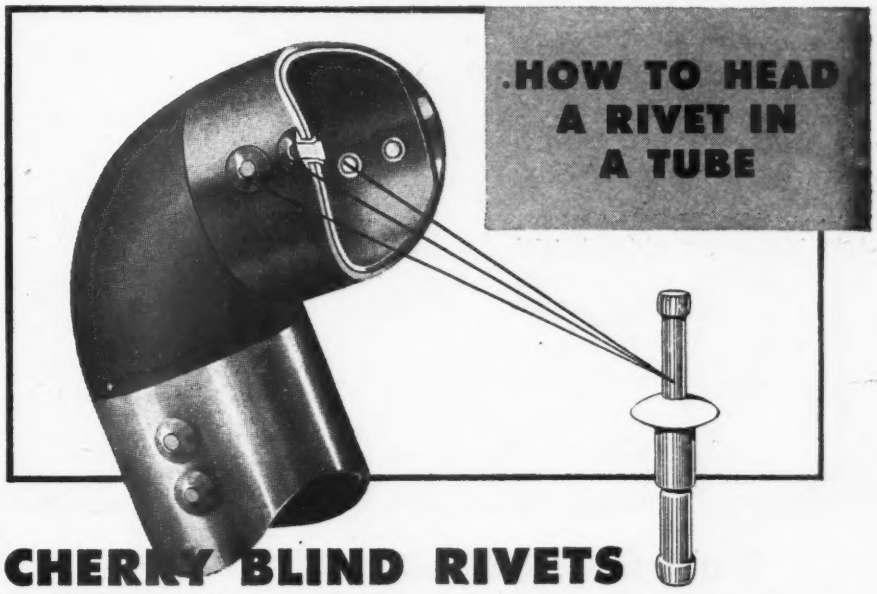
Many times, equipment is at a prem- m in combat areas, and one must be e to utilize the material at hand, no tter how scanty or primitive it may A service man is, in a certain sense the word, a scavenger. His creed to keep 'em flying, and to do that ll use to the best advantage anything the way of equipment—anything m a tree to junk the enemy has left ind.

Service men use oil barrels for saw ses, and they're not particular whether those barrels came from Germany or Japan. They'll use the crotch of a tree for a primitive hoist, and if there's no tree they'll bicker with the natives, buy their houses, and use the hewn timber to build their own V-type hoist. There is always a shortage of spare parts no matter how ample the reserve. Wrecked airplanes are ripped apart, and all parts stored.

There are stories told of American-made warplanes, grounded because of a lack of some vital part or other, which later were sent up again, their engines functioning smoothly, because an enemy plane had been shot down and a part had been stripped from it and modified so that it could be used satisfactorily.

Once, in Africa, there was a shortage of common ¼ size washers. An alert service man, remembering that some of the local coins had holes, amazed the natives by collecting their cash and paying good American money for it. The holes in these coins were approximately of a ¼ in. dia. —so the ships were kept flying.

Another instance occurred in India. P-40's were being used as bomber escorts, but their range was short due to a limited fuel capacity. A Curtiss man had purchased some native trinkets, and



CHERRY BLIND RIVETS

CHERRY BLIND RIVETS are ideal for riveting tubing to elbows, brackets or other tubing. Here, short length Cherry Rivets are headed on the inside of the tubing.

The Cherry Rivet is a mechanical blind rivet headed by means of a mandrel passing through it. A gun exerts a pulling force on the mandrel, expands the shank of the rivet and forms a tulip head on the blind side, the head on outside conforming to the radius of the tube.

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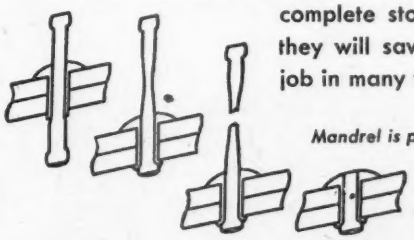

Mandrel is pulled into rivet, expands shank, forms head on blind side. Mandrel is trimmed flush.

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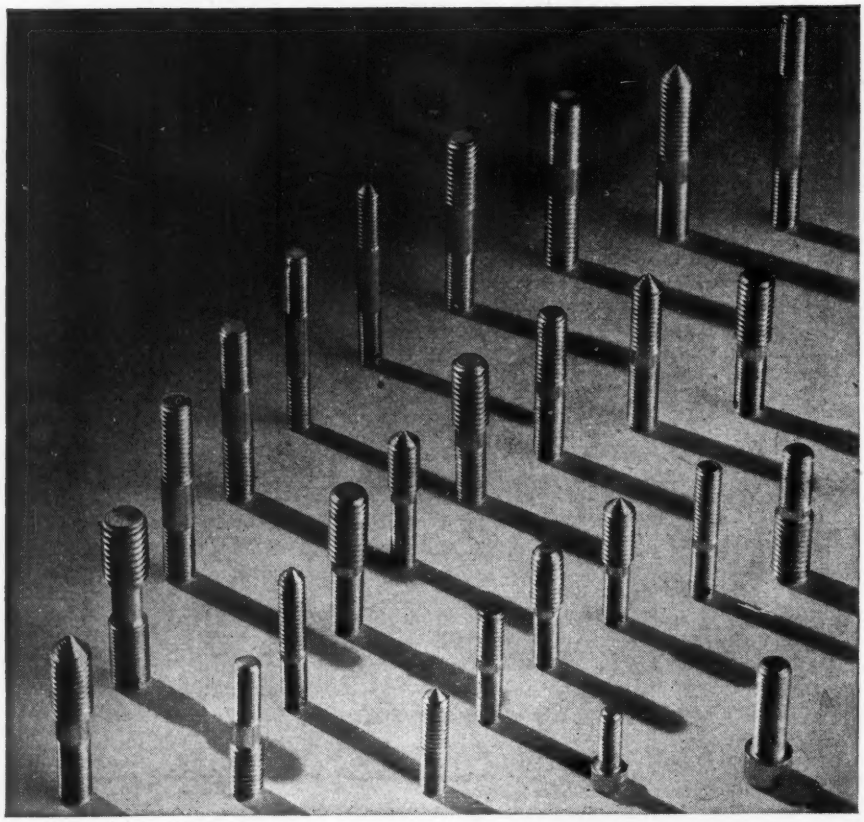

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among them was a cleverly made vase. If the vase would hold water, he reasoned, why wouldn't it hold gasoline? He located some native artisans who made him a container to his specifications—an auxiliary belly gas tank. Thereafter, the P-40's were able to prowl over an extended area, much to the consternation of the enemy.

Warplanes with fuselage and tail surfaces ripped by enemy flak and machine gun fire were repaired with tanned animal hides, fastened in place with native-cured gut. In some sections of Africa, rope needed for block-and-tackle work was scarce. But natives were found who solved the problem by weaving lines from the tough buffalo grass, which grows as high as a man.

In Australia, where the dense bush stretches from horizon to horizon, a ship forced down is like a needle in a haystack. Searching that undergrowth labyrinth is almost a hopeless job, but service men have time and again tackled it, slashing their way through the jungle. To them an airplane is precious machinery that *has* to be found. They always find the plane, and they always bring it back.

They're a great bunch, these unsung heroes of wrench and pliers—and they don't get any medals. They go into battle quietly and return to this country just as quietly, their notebooks crammed with ideas, new methods, airplane kinks they've picked up. They fight a grand fight in this man's war, not with guns but with mechanical knowledge.

P-40 service men have kept their airplanes tuned for action since the opening days of the African campaign, working and sweating with the RAF before their own country had entered the conflict. They've followed their *Warhawks* from El Alamein up through Enfidaville, to Cape Bon, and on to Sicily and Italy. These P-40 service men are still with their ships, following the tide of battle toward Rome and points north.

Reconversion

(*Continued from page* 115)

to keep their own privately owned plants in operation.

It would seem to me that the problem of government-owned plants is one in which the various cities in which they are located should concern themselves.

These are valuable properties which can, with wise planning, be turned to great community advantage. It might be difficult to find single industries which would fill such large structures; but they could be divided to house several new projects which would help take up the inevitable postwar slack in unemployment. And any space that could not be used in this manner could serve

U. S. Army Air Forces Photo

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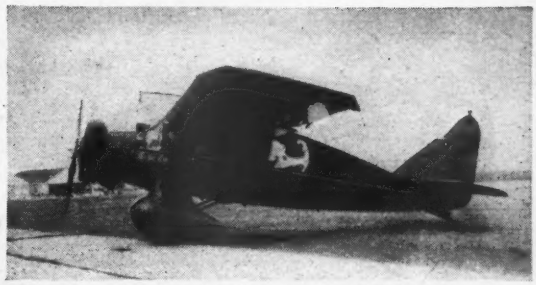
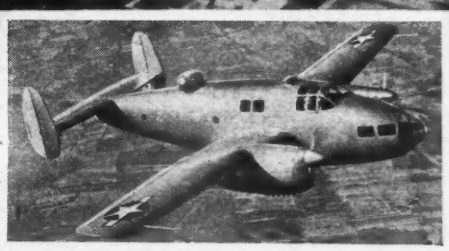


The Cape Cod took off July 28, 1931. With only a 420 hp Whirlwind engine she lifted a total load of over 7,500 lbs., including 749 gals. of gas and oil — flew a world's record of 5,040 miles non-stop to Turkey.

Caption of news-photo says: "The Cape Cod ... as she was guarded from the curious after the arrival at Istanbul." Russell N. Boardman and John Polando were at the controls.

One of the many U.S. Army Air Forces B-24 Liberators that raided Ploesti, skimming in low through dense oil smoke.



The AT-21-BL gunnery crew trainer, now in production at Bellanca Aircraft Corporation for the United States Army Air Forces.

Across the Atlantic... across Europe ... across the Balkans... first to fly 5,000 miles non-stop from New York to Istanbul... that was the pioneering air trek of the Bellanca cabin monoplane which re-captured the world's long distance record for America in 1931. Of greater importance to wartime America was the 1943 raid by Army Air Forces B-24 bombers, first to attack Ploesti and wreck the big Rumanian oil refineries. Theirs was a mission second to none for military daring and success. But the historic Bellanca flight, twelve years ago, was a significant preview of coming American air power. And today, as pioneers of long distance planes, Bellanca engineers are working for Victory in the production of precision-built bomber equipment, vital warplane components and the AT-21-BL gunnery crew trainer. Bellanca engineers are planning, too, for *your* peacetime aircraft of tomorrow!

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storage of war plant machinery or government supply depots.

The storage problem is a very important item in the postwar picture. at, for example, can industrial plants ch have been converted to war industries do with all government-owned s when they wish to revert to the nufacture of their original products? automobile industry, for instance, not turn out cars without bodies. The gest body plant in the U. S. is at sent building airplanes and cannot rn to normal activities until it can rid of vast quantities of airplane ling.

Problems arising from termination of contracts and the resumption of rmal industrial life are numerous and plex. But they all boil down to single problem—the security of iduals who have rolled up their sleeves helped us build the planes to fight win this air war.

To help those who have been assoted with me, I have asked the governnt to consider and approve a new e of bonus. This bonus would take form of an incentive-pay increase wages, based on increased production length of service. It would be cuulative and be payable only after the r, or on final termination of employnt, and would provide a substantial to tide aircraft workers over the iod of readjustment to normal conions in a postwar-world—to aid them returning to their places in the civin activities of the postwar world.

Jet Propulsion

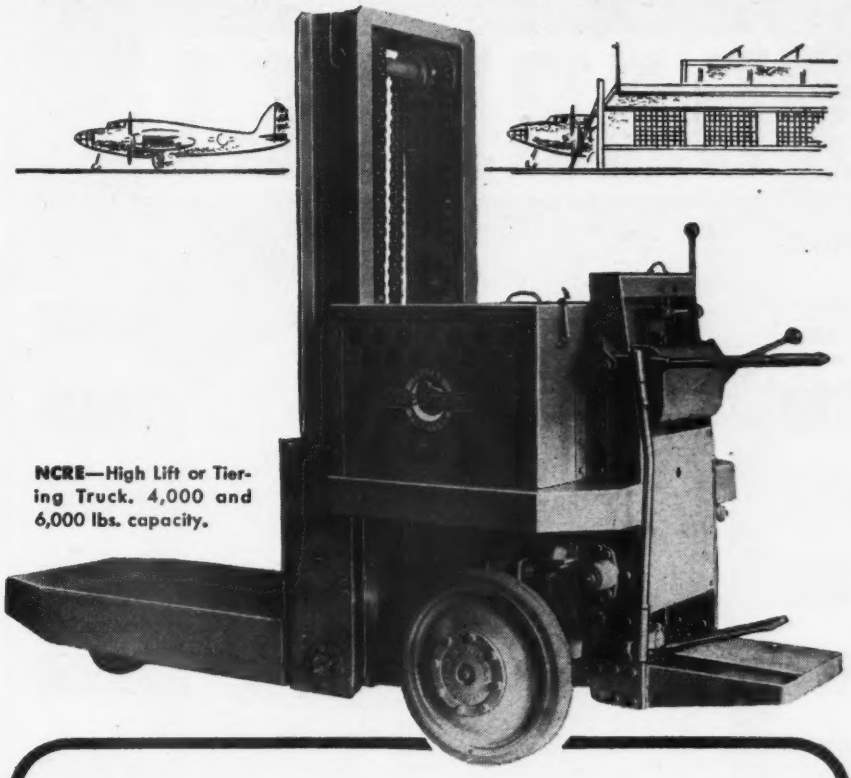
(*Continued from page* 149)

s made on June 11, 1928. The rockets the disposal of the experimenters were the following types:

) 3-sec. burning time with 360 kg. r 790 lb. thrust
) 3-sec. burning time with 175 kg. r 385 lb. thrust
) 3-sec. burning time with 75 kg. r 165 lb. thrust
) 30-sec. burning time with 20 kg. r 44 lb. thrust
) 30-sec. burning time with 5 kg. r 11 lb. thrust

Types 1, 2 and 3 had the customary ter bore which does not reach all way through and which has the rpose of increasing the burning surce, while types 4 and 5 were solid kets without a bore, known in the de as "branders" (Fig. 6).

The tests with models were made first, d almost all of them turned out badly. e rockets proved to be far too powerl for the models. They took off "like ojectiles", as the reports put it. The kets tried to tear off the wings, d the models crashed because they



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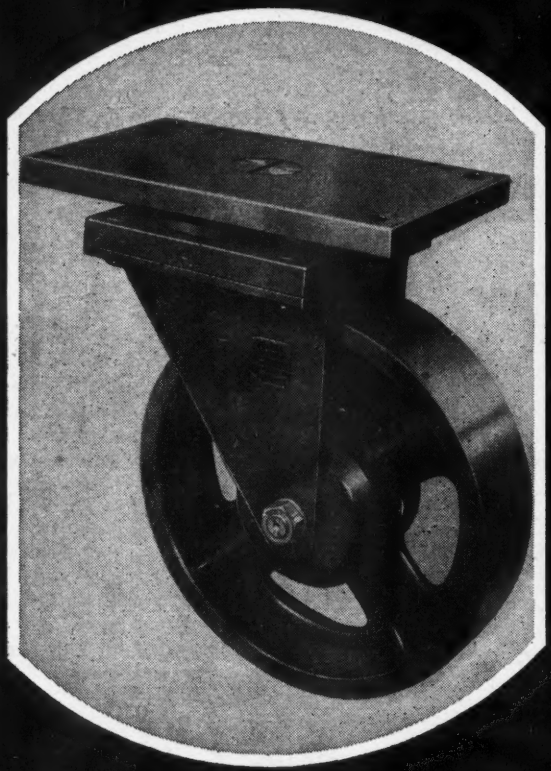

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CASTERS

either were in unstable positions when the rockets gave out, or had been damaged by the acceleration, or both.

As a result of these experiences, the most powerful rockets were discarded for the duck glider. Only two solid branders, of 26- and 33-lb. thrust, respectively, were installed in the craft, which was to be piloted by Friedrich Stamer. The two branders were wired for ignition in such a manner that only one of them could be ignited at a time, no matter what the pilot did.

In spite of all these precautions, Stamer had to report* that the first two attempts failed. In the initial trial, something went wrong with the launching rope and the one brander which had been ignited by mistake before the glider was in the air, merely burned out. In the second attempt, Stamer did not succeed in balancing the glider correctly. He landed after traveling about 700 ft. and without igniting the second brander.

The third attempt was made after thorough inspection of the glider. It was then fitted with two 44-lb (20 kg.) thrust solid branders. Quoting Stamer's report:

"The plane took to the air by means of the rubber rope, aided by one rocket (brander). After flying for about 200 m. in a straight line (I noticed a slight climb) I made a curve of about 45 deg. to the right and flew for another 300 m. Then I turned again to the right, again about 45 deg. Immediately after the (second) turn, the first rocket ceased burning and I ignited the second. . . . This time I flew about 500 m. in a straight line, made a turn to the right of about 30 deg. and landed the machine after another 200 m., just a few seconds before the second rocket was exhausted."

The distance covered was about 1 mi. in a little more than 1 min. of flight. Asked about his impressions, Stamer declared that it had been "extremely pleasant", and he added: "I had the impression of merely soaring, only the loud hissing sound reminded me of the rockets." To continue the report:

"For the next flight it was planned to climb over a small mountain. The launching went all right, and while the plane took to the air, I ignited the first rocket. After one or two seconds it exploded with a loud noise. The 9 lb. of powder were thrown out, and they ignited the plane instantly. I let it drop for some 20 m. to tear off the flames. After succeeding in that, I landed the plane without mishap."

Just after landing, the second brander caught fire, but fortunately it just burned out without exploding. The fire, however, had damaged the glider to such an extent that extensive repairs were

* In *Zeitschrift für Motorluftschiffahrt und Flugtechnik*, (ZfM), Vol. 19, No. 12. June 28, 1928.

necessary. As a consequence, the experiments were then broken off and not resumed. Nevertheless, a few similar experiments followed in the wake of them.

The Raab-Katzenstein airplane works at Kassel built a full sized plane of the same type as that depicted in Fig. 5. For unknown reasons, the first attempts failed, and Raab-Katzenstein gave up. But at about the same time, Fritz von Opel had a rocket glider built, and he tested it on Sept. 30, 1929, near Frankfort-on-Main.

Two tests in the morning failed because the rocket batteries did not develop enough thrust. (Opel took off without rubber rope or other aid). The third attempt in the afternoon of the same day led to a flight lasting about 10 min. in the course of which 100 mph. were attained. But the plane was not rigid enough. Also, the wings caught fire in the air. Opel succeeded in landing unharmed, but the plane was ruined.

Opel's experiment was repeated some three years later in Italy. Then in 1931, the Italian engineer Ettore Cattaneo tested a 620-lb. glider-type rocket airplane at Milan. During one of these tests, the craft remained in the air for 34 sec., traveling a distance of 1 km., or roughly two thirds of a mile.

The experiments of the Rhön-Rositten Gesellschaft had a definite purpose. They were to test the feasibility of an oft-made suggestion to substitute rockets for rubber rope or car tow for the takeoff of gliders. Rockets for takeoff seemed promising not only because they would permit a glider pilot to take off without help, but because it also seemed likely that he could carry along two or three rockets for other takeoffs after intermediate landings. The idea was abandoned reluctantly because powder rockets were not considered safe enough, since the tendency for them to explode could not be eliminated.

The idea of the takeoff, or launching, rocket was also advocated for regular planes in German aviation magazines at that time, on the theory that any plane needs more power for the takeoff than it needs in flight. The idea was suggested to save the extra engine power and gasoline consumption by equipping planes with only as much engine power as was needed for cruising and providing the extra power needed for the takeoff by means of rockets.

Prof. Hugo Junkers, then still alive, tested at least part of that idea by taking a single-engined Junkers plane with floats—the same type which made one of the first transatlantic flights—and fitting it with a battery of powder rockets. He overloaded it to such an extent that it could not conventionally take off anymore. Just how much it was overloaded was not stated, but the

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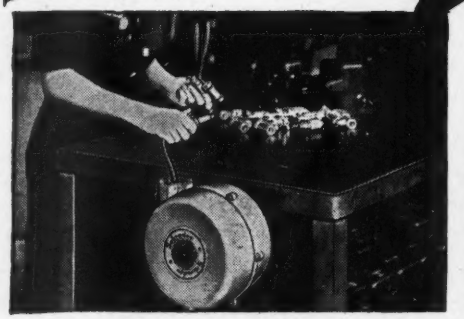

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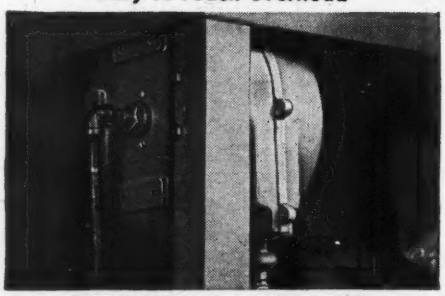

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normal takeoff weight of these planes was around 3 tons. At any event, the takeoff of the overloaded plane with the aid of the battery of rockets was successful.

This experiment had been made in great secrecy in Aug. 1929, and nothing was heard of it again until it found practical application during the Battle of Britain. The Luftwaffe then launched overloaded bombers from small improvised airdomes in Holland and Belgium. The bombers had a kind of metal grating fitting the bottom of the fuselage and carrying the rockets, which were ignited electrically by the pilot when the engine was running with full power. When the rockets were exhausted, the grating dropped off the plane, which was by then in the air.

America at War

(*Continued from page* 113)

England—with all the jet impellers, or whatever he has in that bag—are a giveaway. The air war is being fought with standard equipment, all two, three, five or more years old, subject to improvement as fast as design changes can be proved up. The Germans know it all too well, for that is the way they beat their European neighbors to death and socked England a stunner. The trick weapon thing will certainly fail.

You cannot separate technical talent from productive power, because one is no good without the other. Technology, like productive power, takes a lot of man-hours and requires top spirit and the backing of the whole people. On that basis it can be shown that Germany is failing, not only in production but also in technology, while the Americans, the Russians, and the British all are on the climb in development. A general told a newspaper man recently that the Germans are losing not because they are in retrogression but because the Allies are improving—which is perhaps a better way of putting it.

No better summary of this thesis could be found than a statement made recently by Col. Frank C. Wolf, chief of the armament laboratory of the Army Air Forces Materiel Command. He has listed 19 firepower improvements which have made American aircraft increasingly formidable.

The Colonel cites: heavier caliber machine guns, heavier millimeter rapid-fire cannon, power operated turrets, remotely-controlled and power-boosted machine guns, remote fire-control systems, increased gun power in both nose and tail positions, interchangeable nose turrets for a light bomber, multiple 37 mm. cannon mounts for forward fire, multiple gun turrets for night fighters, forward-firing fixed 20 mm. cannon in a light bomber, automatic firing correc-

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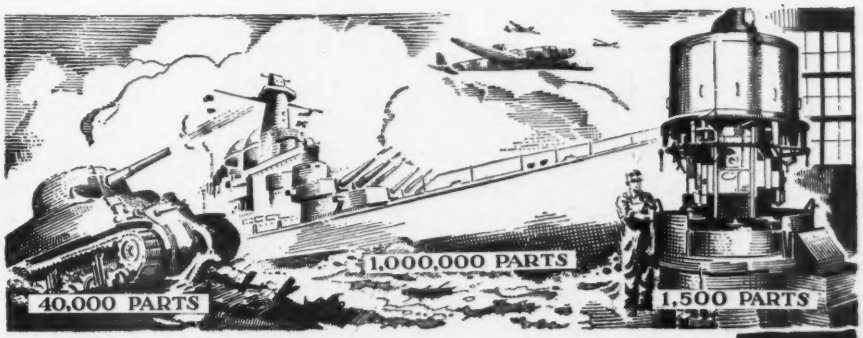

Until the one-piece machine is built we'll be dealing with *parts.* And the parts of production- and war-machines are made of the strongest suitable materials. These seldom fail in the unit; they commonly fail in the assembly. Something—just one fastening—lets go, and the machine *in toto* quits. Try to figure the cost in a hard-pressed tool-room, or a still more hard-pressed battle line!

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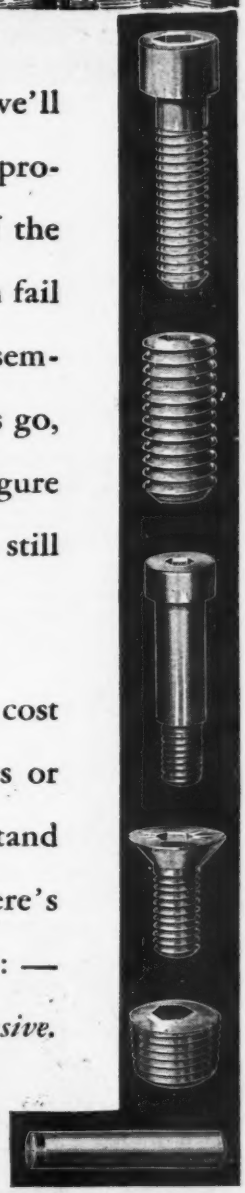

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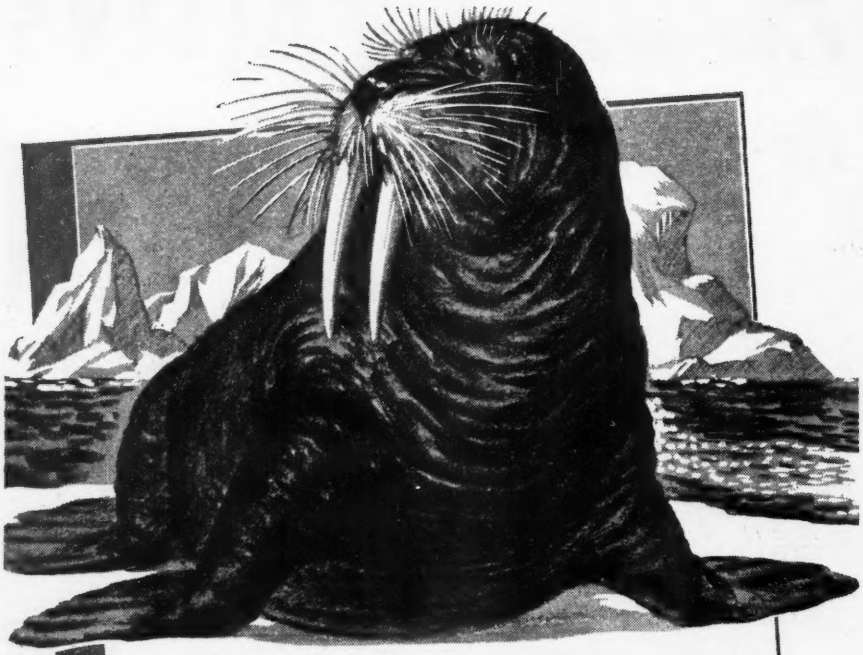

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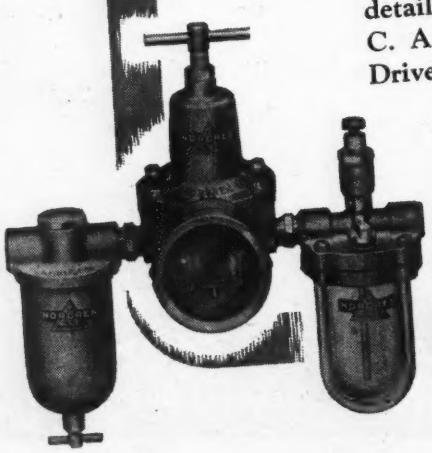

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tion in fixed fighter guns, improved computing sights for all gun positions, guns placed for maximum protection, fighter gun sights that extend sighting range, combination gun sights and dive bomb sights, personnel flak suits and armored helmets, improvements in armor plate and bullet resisting glass, and improvements in gun-sight aiming-point cameras. In addition, Col. Wolf said there are about 70 airplanes of different types at the Wright and Eglin testing fields.

The above list deals with gun phases only; if all phases of military aircraft development were included, the list would be pages long. Projecting Col. Wolf's report into the future, one may reasonably conclude that the crews of combat planes will be concentrated behind armor, with controls leading to all guns. Official statements recently have mentioned airplane armor a half-inch thick. Presumably this refers to super-heavy bombers.

Next thing you hear it will be an inch thick, and the contest between fire power and armour will go on and on, as it has for years in warships—and as it did in tanks. It is worth noting that the race seems to have been won by the guns in the case of tanks. But don't bet either way in the air.

Despite the aforesaid 70 test-model aircraft there now seems to be a combining and narrowing of the many functions of warplanes into fewer types. The principal planes in Allied forces are now doing something of everything. That is, the bombers and fighters and patrol jobs are all bombing and fighting and patrolling. There is still much difference between a heavy fighter and a medium bomber, but there is becoming less all the time. Fighters are doing more bombing every day, and the bombers are becoming more maneuverable for fighting work. No one can say whether the paths of these types will cross making them one and the same thing in the future. For the time being, the fighters are taking on more assault and bombing power because of increasing engine power. Furthermore, they are getting more range. Any day now you can look for news that fighters are escorting bombers to Berlin in full strength.

We have beaten the Germans in technical development, but we are not even in a technical contest with the Jap. Air Force officers still say, after two years of air war with Japan, that Nip equipment is almost a hundred percent copycat. The Jappos appear not to have achieved a single major development in aviation. But that doesn't prevent them from building a lot of pretty good airplanes that will kill a lot of people.

If you were a Jap (sit down, we're just pretending) this is how the war would look to you: Your belief that

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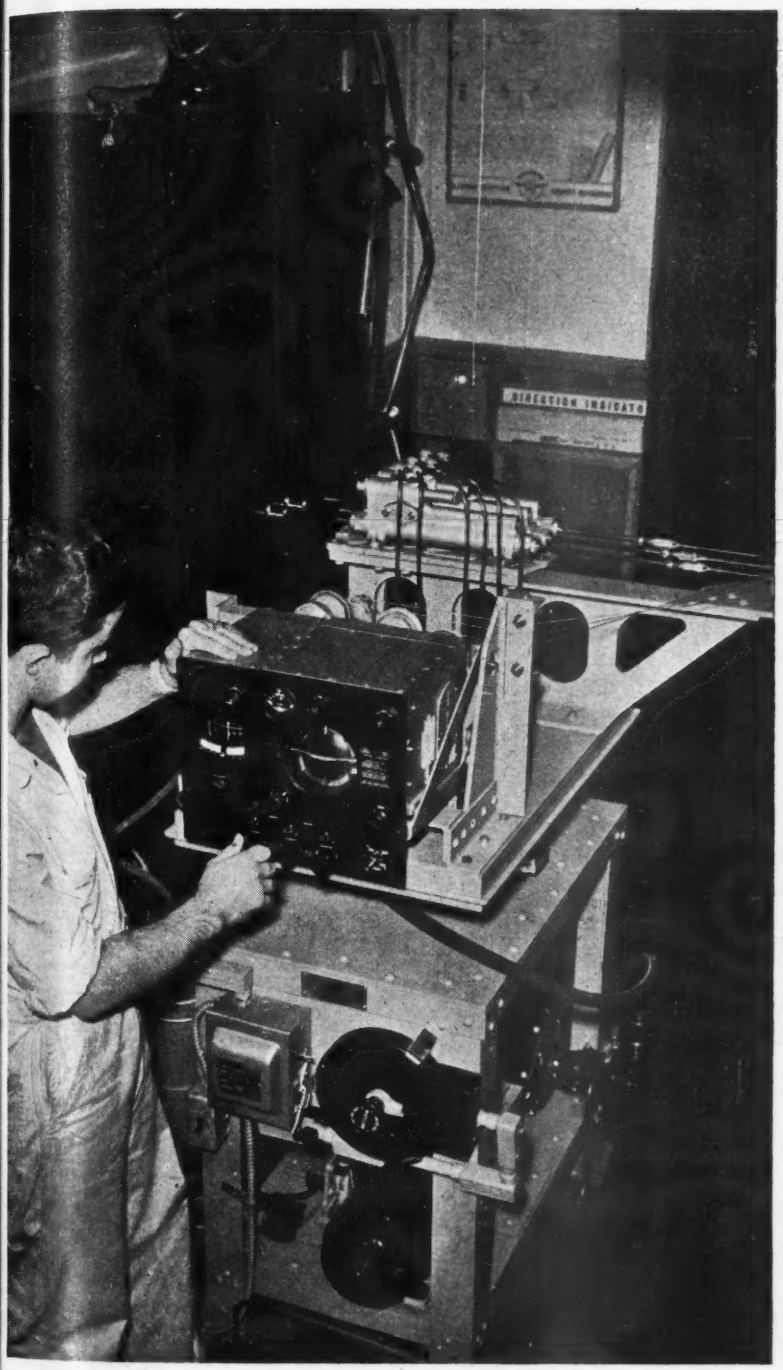

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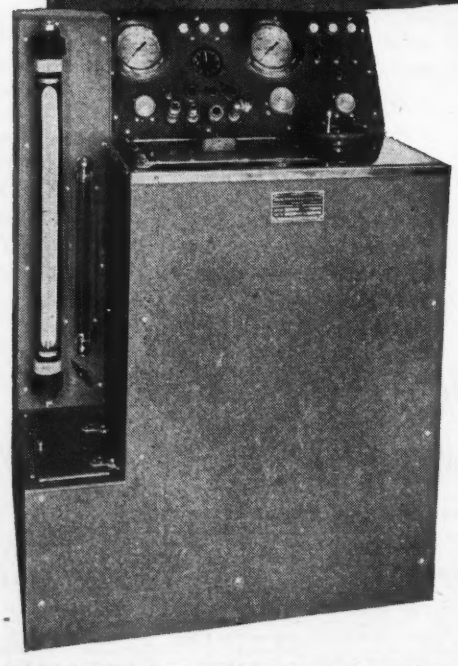

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you and all your bunch are sons of heaven and destined to rule the earth has been confirmed in the Mikado's capture of an enormous empire. You have held it for two years, and the enemy has merely chipped off a piece here and there and killed a mere few thousand of your soldiers. True, your air missions and your naval forces get licked in 99 out of every 100 contacts, but if you are one of the herd you don't hear of it, and if you are an official you dismiss it, because those things have only happened 'way out on the rim of your empire. From where you sit, none of your industrial or population centers or true military strong points are within effective bombing range.

All the ingredients of collapse are present in Hitler's set-up, but none of them is visible in the Jap drive. It still has to be hammered into them, with heavy blows, as the President said, all the way from Paramushiro to the Netherlands Indies. It may be said that we are still "consolidating" along the routes to Australia.

But Allied blows wear the Japs down. MacArthur is turning them back with less than 5 percent of U. S. war power. In November the Japs lost 553 planes and 74 merchant and naval ships against 91 American planes and 1 destroyer. That loss to the Japs is pretty heavy. From the estimate standpoint it's about half of their total monthly production.

Several of the world's longest bombing missions have been flown against the Jap island positions lately, and Maj. Gen. Willis H. Hale, commanding the 7th Army Air Force, says the air attack will get truly tough.

Invasion of the Gilbert Islands and the taking of the Tarawa stronghold comprise the first step, according to Navy Secretary Frank Knox and Adm. Chester W. Nimitz, commander of the Pacific area, in a new plan to fight a direct northwest route to Japan proper. This does not mean that progress will be island-by-island. The eventual concentration of British and American aviation and seapower in the East will enable the Allies to bypass the pinpoints and attack the major approaches to Japan.

The big moment everyone is waiting for, of course, is a show-down battle of fleets and attacks in force by the B-29's. Gen. Claire L. Chennault's 14th Air Force is needling the Japs in China as best it can, almost entirely cut off, except by air at too-long range. Meantime, you can take all but official comment on plans for attacking Japan as pure guesswork. Just get a map and make your own.

For the record, some notable events of recent weeks: After centuries of dry death at sea, this war brings several ways of unsalting sea water for people adrift, frequently airmen. The Allies

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attacked the Balkans, in long-winded B-25's. AAF hit Norway from England, 700 mi. farther than the run to Berlin. If Stalingrad was the turn of war in Russia, the crushing of Berlin by Allied bombers may mark the last mile in Europe. The greatest all-time assembly of carriers went to the attack on Wake Island. A B-17, picturesquely called the "Knockout Dropper," completed its 50th mission in the mission to Norway. A flight of 8th Air Force heavies went 1,300 mi., exposed to enemy attack without escort. American bomb-carrying fighters made their first attack in force on European objectives. The death toll of bombs on Europe reached 10,000 to 15,000 persons per day of full-scale action.

Here at home the big news was the "up" in airplane production, which climbed over the hump as a result of long and arduous efforts by many people representing the industry, labor, and the government—so many of them that not even the leaders can be named in this space. If you had to pick out just one for special honors, Charles Wilson, chairman of the Aircraft Production Board, would be as good a candidate as any. Manpower, last of the aircraft problems, is just about licked, and production takes on the kind of roll that's been diligently sweated for these two years.

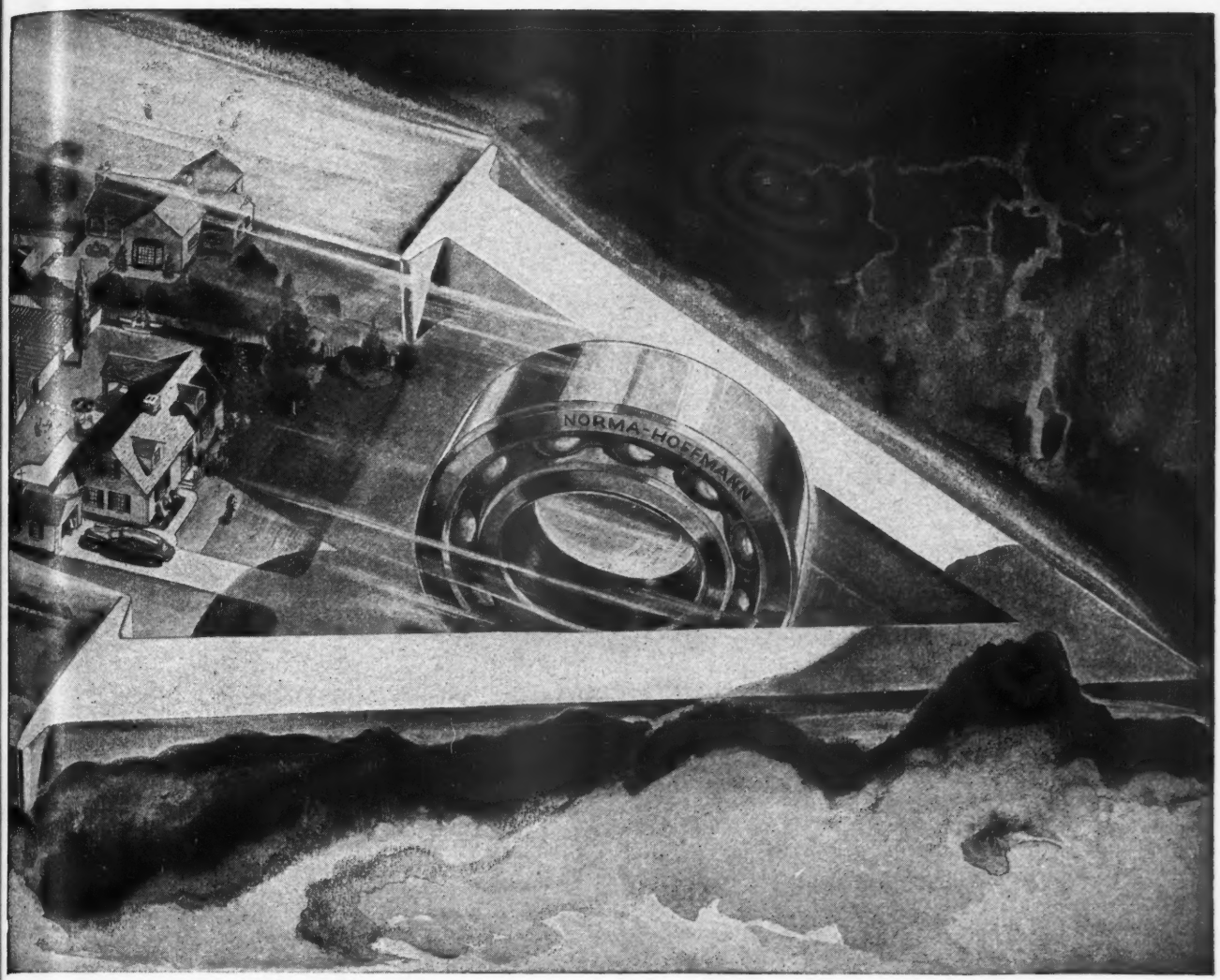
Indications are that domestic air legislation, of which the Lea bill is the keystone, is inseparable from foreign air policy and therefore will be in process for a long time yet. Viewed from Washington, it looks as if every government agency and private interest you can think of has an oar in the business.

Everybody is keeping a sharp eye on progress in postwar problems. There is only one way to sum that up, short of a two-hour harangue: The planners are moving inevitably toward combining contract termination, plant liquidation, disposal of surplus equipment and dispersal of manpower, all as one big job. One cannot be considered without the others. The program will all be under one head, possibly the War Production Board, but the same agencies that mobilized war production will be directly responsible for demobilizing it.

Cruise Control

(*Continued from page 227*)

Complicated charts and graphs have been efficiently utilized by these trained flight engineers in efficient flight planning. In applying efficient cruise control procedures to operations which cannot support the presence of a flight engineer, simplification becomes a paramount issue. Such simplification, however, should be accomplished only after



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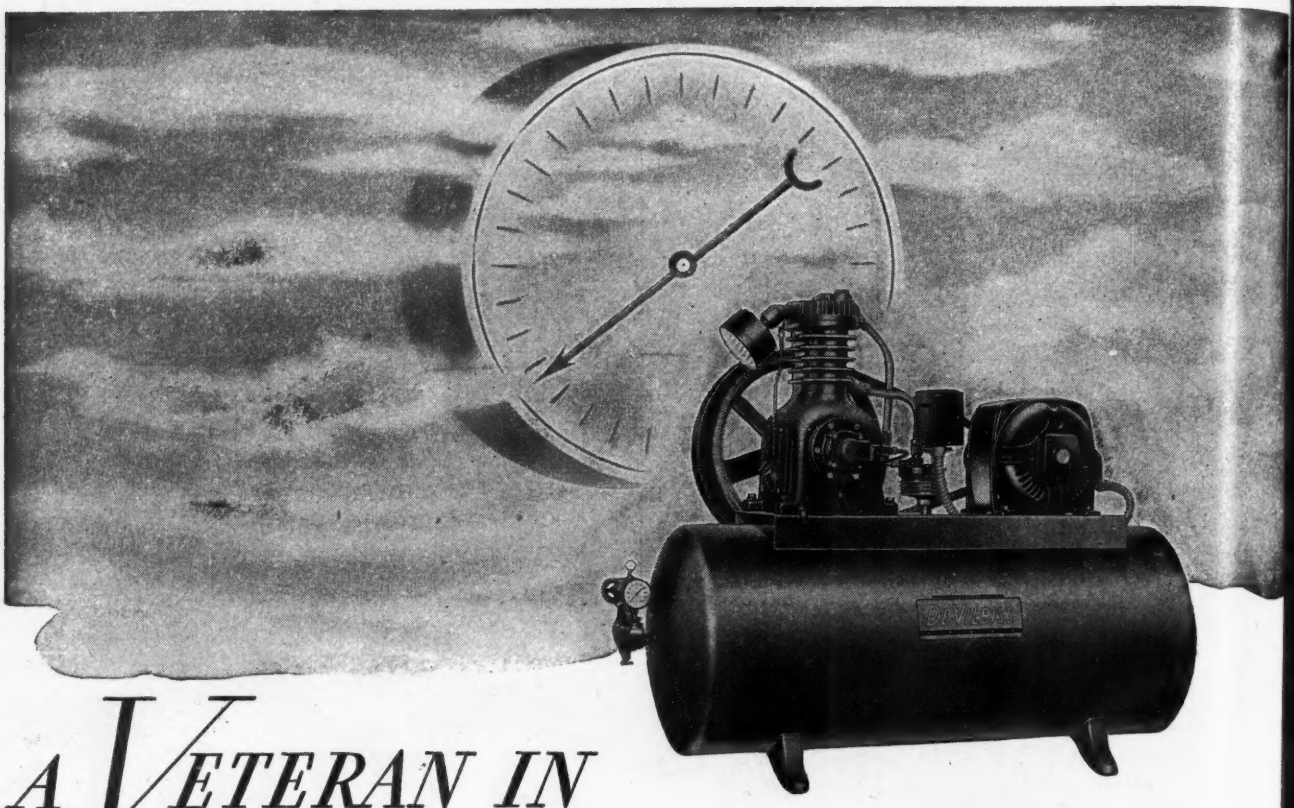

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an extensive engineering analysis has been made to determine the most efficient simplification possible. In this regard, two basic questions must be answered in the analysis: First, what degree of simplification is required? Second, which power control system is most efficiently applied—with the specified degree of simplification under the expected conditions of operation?

In operations where flight engineers are engaged, it is considered that there are numerous potentialities for simplification of cruise control procedures without loss of over-all operating efficiencies. Such simplification would release the flight engineer for other duties as well as improve his contribution to the safe and efficient conduct of a flight.

Also, simplification of some flight engineering procedures which are presently too complicated for the average flight engineer would allow an improvement in cruise control efficiencies. The variation of propulsive efficiencies with engine rpm., airplane speed, and altitude of flight is a factor which exemplifies a potentiality for simplification from the theoretical and flight test status to a practical airline operation procedure.

Probably the most valuable instrument which could be added to the instrument panel of a transport plane, in the interests of improvement in cruise control efficiency as well as simplification of procedures, is the horsepower meter. An accurate horsepower meter would eliminate the complications and inaccuracies of present day power setting procedures, as described in a previous article of this series.

Improvement in Accuracy of Fuel Consumption Indicators

Fuel consumption indicators are of two basic types. One designates the actual rate of fuel flow to the engines in either gallons per hour or pounds per hour. The second type continuously indicates the total quantity of fuel on board an aircraft at any time. By analyzing these readings over periods of time, the rate of fuel flow can be determined.

Neither type of indicator has been developed in practical models to sufficient accuracy to be considered entirely satisfactory. The best fuel flowmeters are accurate only within operating limits of 2 percent. Such an accuracy would appear to be good in comparison with other instruments.

Importance of the fuel flowmeter, however, in insuring safe and efficient cruise control is such that an improvement in accuracy is strongly desirable. For example, on a transocean hop normally requiring 3,000 gal., the possible error of 2 percent requires that 60 additional gallons of gasoline must be placed on board the airplane to allow for the fuel flowmeter error. The 60 gal. then repre-

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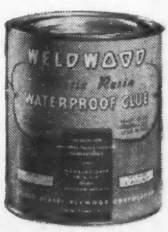

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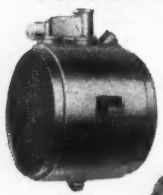

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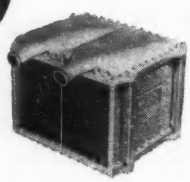

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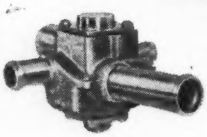

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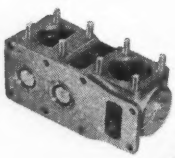

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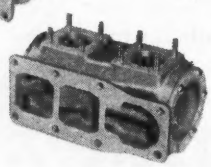

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sents the removal of 360 lb. of payload.

The fuel quantity type of instrument is inaccurate to varying degrees. At best, the accuracy is consistent only to within 5 percent and in some transport installations of the last few years the accuracy of fuel quantity gages has not been dependable within 20 percent which, of course, renders the instrument useless for purposes of cruise control.

Improvements in Specific Fuel Consumption Charactistics of Aircraft Engines

"Pounds per brake horsepower hour" is the most widely used term for measure of specific fuel consumption. The normal value in domestic air transport operation of specific fuel consumption has been approximately .45 lb./bhp./hr. for normal cruising operations. Possibilities for improvement in present day engines would appear to be great, judging from values which have been attained under carefully controlled operational as well as test conditions.

Many proposals have, of course, been offered for improvement in this field. Diesel engines, improved carburetion systems, improved fuel, and better engine design all give promise of lower fuel consumption in the future. The factor of fuel consumption must be recognized to be of an importance which increases considerably with long-range operation.

As an example, let us take two airlines operating between New York and London with one stop. One airline operates airplanes equipped with engines which have a specific fuel consumption rating of .45 lb./bhp/hr. while the competitor operates similar airplanes at a rating of .405 lb./bhp./hr. a better fuel consumption by 10 percent. If the normal payload is 4,000 lb. and the normal fuel load is 3,000 gal., then the improvement of 10 percent in fuel consumption will allow an increase in payload of *45 percent* (1,800 lb.). The operator of the more efficient equipment can then either operate at reduced rates or realize much greater profit at the same rates of revenue.

The improvements in engine fuel consumption must not, of course, be at the expense of reliability of operation. At the same time, however, the engine designer must be made to understand the value of engine fuel economy, which extends beyond the immediate saving in fuel consumed. Actual value of the 300 gal. of fuel saved in the above example may be worth less than $60—yet the additional 1,800 lb. of payload made possible by the fuel economy will have a value of $2,000-3,000 for each transatlantic flight made.

Improvement in Flight Dispatch Procedures

Many methods of flight dispatch have been evolved and are in operation. These

U.S. ARMY AIR FORCE PHOTO

The "Focus Cats" are on the Prowl over Fortress Europe Tonight

WHEN you pick up your paper tonight and read of another relentless Liberator, Fortress or Lancaster bombing attack, the kind which are gradually pulverizing Nazi industry into a pile of so much brick dust, say a prayer for a fearless little group of flyers who, days ago, armed with only a battery of cameras, flew up and down *Ack Ack Alley* in a hail of hot steel to make it all possible.

These flyers, affectionately dubbed the "Focus Cats," are the Photo Reconnaissance group working with the Eighth Air Force. Prowling the backyards of Hitler's Fortress Europe, they have already mapped a good part of what is to be the Second Front. Their work is picking the targets for tomorrow. Their lenses have been trained on every acre of ground over which, eventually, Allied soldiers will drive toward Berlin. When the time comes, Allied troops entering occupied countries, even Germany, will be familiar with every foot of terrain that lies ahead.

The large missiles pictured above, wicked enough looking to be their death-dealing cousins, are flash bombs—but one of the highly important manufacturing tasks in chemical engineering assigned to McAleer. Timed to explode out of the camera field, they turn darkest night into daytime brilliance and make picture taking possible from as high as four miles above the ground.

Military pyrotechnics alone are not all of the *For-Victory* products of the McAleer Company. There are others which extend into the fields of military aeronautics and hydraulics—yes, and embrace our complete industrial finishing facilities as well. *ON THE HOME FRONT* we fight the war, too . . . by furnishing *quality-controlled* finishing materials and methods which help most industries contribute more to the war effort. If increased finishing efficiency can help YOUR war effort, our advisory facilities are at your service.

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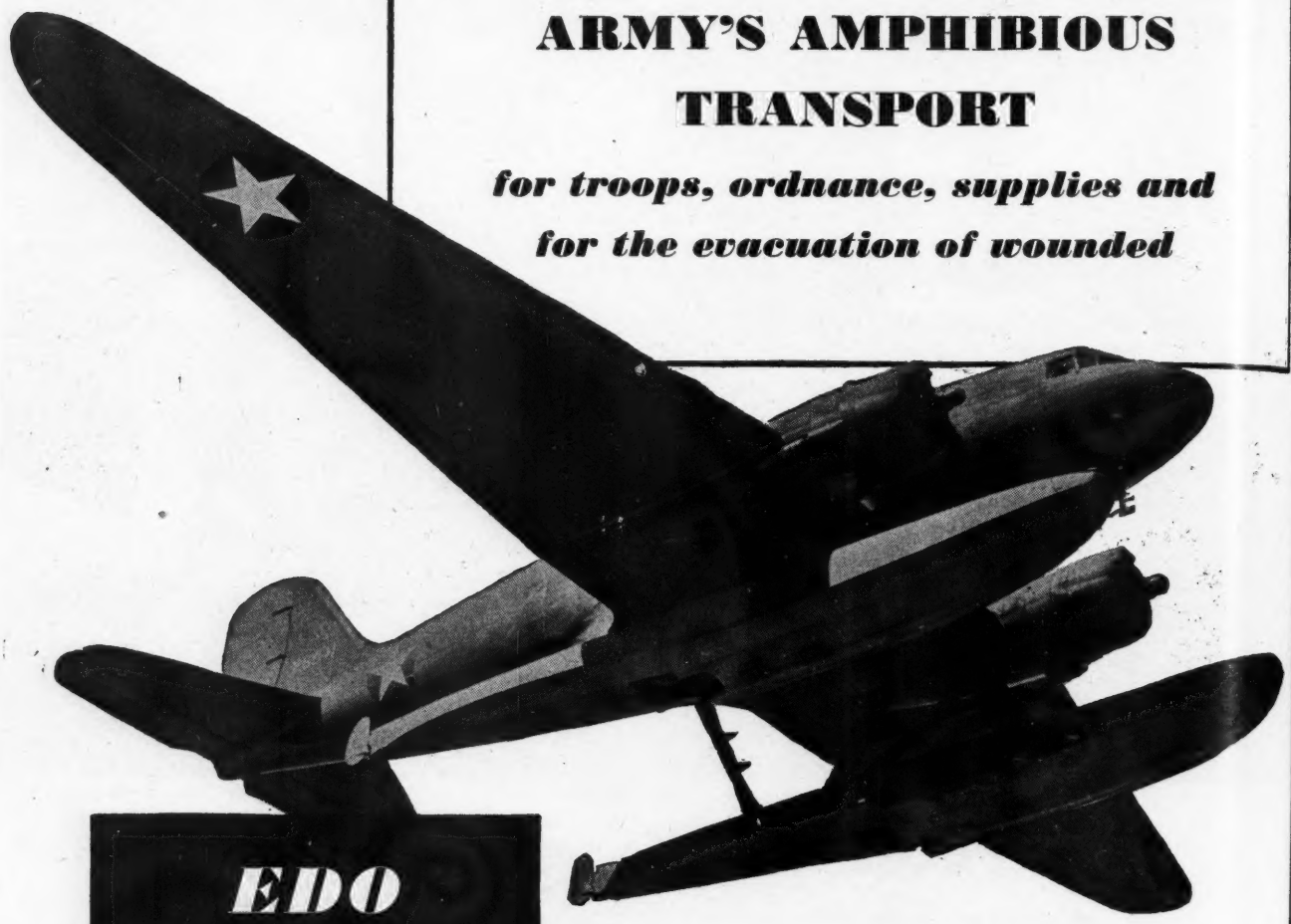

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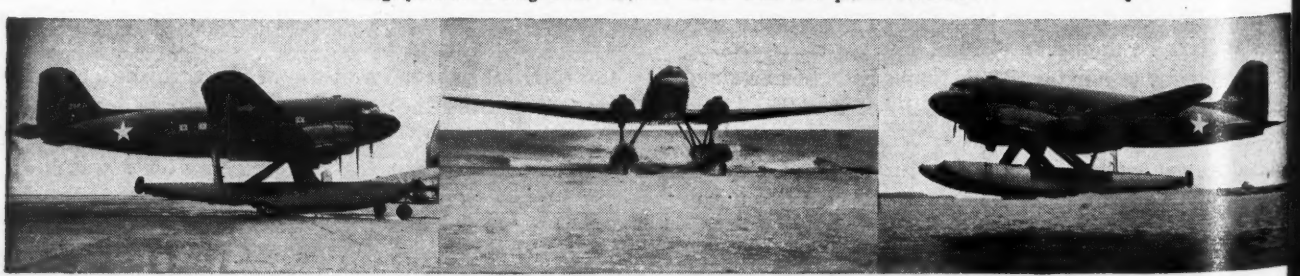
ARMY E NAVY

Photographs show the Douglas C-47 "Skytrain" on Edo Model 78 Amphibious Float Gear.



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rocedures vary in the responsibilities d authorities assigned to the two eople who are directly involved in any ight clearance—the flight dispatcher d the flight captain. Some systems e based entirely upon the judgment of e flight dispatcher, while others de- nd entirely upon the flight captain. asically, the decisions which must be ade in flight dispatch procedures, re- rdless of the type of system used, solve themselves into these two ques- ons:

1. Are flight conditions such that e flight can operate with safety?
2. How much gasoline is required to sure a safe operation?

Both of these questions are at present swered through conferences, exchange opinions, and basic experience of the ersonnel involved.

The potential for improvement in the ight dispatch procedures is considered lie largely in provisions of analytical ds for personnel involved in making ese decisions. Such aids should be de- gned to effectively help analyze the isting atmospheric conditions. The nalysis thus provided should be of sub- antial aid to the personnel who must rry the responsibility of flight dis- tching.

In general, the problems of improving ruise control are mainly concerned with quipment efficiency. It is only natural at questions of basic reliability have ways been considered of such impor- nce as almost completely to overshadow quipment efficiency. Progress of aero- autical engineering and the competi- ve future is such, however, that equip- ent efficiency will become of greater d greater importance.

One-Man Dolly

(*Continued from page* 224)

ere was only a .002 in. clearance be- ween propeller hub and shaft.

Kittel's machine consists of a me- hanical ram to lift the blades to the roper level, with a supplementary and-operated hydraulic ram with a antilever shaft attached to a rack and inion gear, which moves the propeller orward, projecting it above the plat- orm to the engine shaft. The shaft as a travel of 22 in. The mechanism is ounted on a horizontal, Y-shaped dolly ith three rubber-tired wheels. An at- ched handle enables the operator to ull it along like a wagon.

An "L"-shaped arm is attached at ight angles to the cantilever shaft with he base part of the "L" parallel to the oor. The base of the "L" fits between wo of the propeller blades, and a yoke t the top of the "L" cups around the hird. A safety catch at the yoke locks round this blade and prevents the pro- peller from tipping outwards. All points where the arm touches the pro- peller are protected by rubber pads.

The supporting arm has a two-way swing—horizontal and vertical—so that the orifice in the hub and the crank shaft can be lined up without changing the position of the dolly.

In mounting, the propeller slides from the painting rack onto the dolly's arm, is locked in place by the safety catch, and is then wheeled to the ship. Next, the electrically controlled me- chanical ram is operated, raising the propeller hub to approximately the same height as the shaft. The final height adjustment is accomplished by a few strokes of the hand-operated hy draulic ram, raising or lowering the propeller the fraction of an inch neces- sary to meet the .002 in. clearance With a slight swing of the arm for alignment, the propeller slips onto the shaft. Then the safety catch on the yoke is removed, the arm is lowered to clear, and the dolly is wheeled away

The entire operation can be com pleted by an untrained operator in about 7 min., while a worker familiar with the procedure can do it in 5 min or less.

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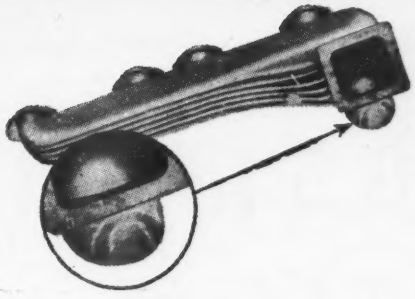

NO GENERAL PREHEATING REQUIRED FOR WELDING CAST IRON

PROBLEM

How to repair this cast iron exhaust with a color matching, heat resistant weld? With high temperature, fusion welding there was great risk of stresses, new cracks, and distortion even in the hands of the most skillful welder. Bronze brazing could not be used since the job requires a perfect color match.

SOLUTION

Eutectic Low Temperature Welding Alloy No. 14 was tried. Its low binding temperature (950-1400°F) eliminated risk of stresses, new cracks, and distortion. Many jobs require only slight local preheat • Weld has high heat resistance • Easily machinable • Perfectly color matching.

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Alloy No.	Purpose	Binds at °F.	Tensile Strength, Lbs. p.s.i.	Machinable
15	Filling cracks, defects	354° - 600°	1,140 (pressure)	Yes
14	High strength joining	950° - 1400°	48,000	Yes
16	Joining cast iron to steel	1300° - 1600°	117,000	Yes
248	Cast iron not subject to stresses		38,500	Yes
24	Cast iron subject to stresses		20-30,000	Yes

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Harvey, Ill., has been licensed by the inventor to produce this propeller positioner for other aircraft manufacturers.

Postwar Appraisals

(*Continued from page* 119)

before that type of craft can safely be put into the hands of the public.

As to the conventional light airplane: Yes, here we are going to have a substantial development. By the time this war is over, we will probably have 300,000 of our sons who have learned to fly. Those whose economic conditions will permit, will want to continue to fly. But that still leaves us other hurdles to be surmounted. Even if we assume that through increased quantity we can substantially lower the first cost of the private owner airplane, we are confronted with substantial operating and overhead expenses. The CAA has estimated that prewar direct flying costs in such planes amounted to approximately $1.80 per hour, while fixed overhead costs averaged about $840 a year. Assuming an annual use of only 100 hr., we have an hourly cost of $10.20, which is reduced to $3.48 an hour if the annual use is increased to 500 hr.

Further, until there has been developed a combination air-road vehicle, which is not yet on the horizon, the limitations on aircraft operation and landing areas require that it be supplemented by automobile ownership. Too, there are problems of traffic control in the air as well as on the ground. If, as is expected, the skies over America after the war will be criss-crossed by scheduled air transportation, then those airways must be protected from the itinerant pilot. That is a limitation which will adversely affect wide-spread use of the private owner aircraft, especially when it is remembered that as far back as 1939 there were approximately 11,000 aircraft in civil use in this country.

The third category is the commercial field, and it is here that I feel that the greatest relative growth will occur, and it is in this field that the wisdom of governmental policy and regulation will have its most profound effect. It should be remembered that in 1939 the total of all aircraft engaged in scheduled air transportation in the United States was but 265. Those aircraft served 200 scheduled airline stops—and within a 25 mi. radius of those 200 stops were located 55 percent of our total population.

The 1941 report of the Interstate Commerce Commission reveals that of all passenger miles covered on railroads, highways, and airlines, the distribution was approximately as follows: Railroads 9.71 percent, highways 89.2 percent, and airlines 0.44 percent. This, despite the fact that in the six year period from 1935 to 1941, we experienced a 500 percent growth in passenger miles flown on domestic scheduled air transports. During this period the ratio of airline to Pullman traffic increased from 3.9 percent in 1935 to 13.7 percent in 1941.

However, here the cost differential between the two means of transportation was relatively small, the airline rate being 5.1c. per mi. compared to the Pullman fare of 4.3c. Further advantages of air travel were in complimentary meals and, frequently, more direct routes with lesser mileage. At the same time, railroad coach rates averaged 2.2c. a mile and bus rates 1.7. Progress is being made toward reducing these differentials. The *direct* flying cost of the 21-seat Douglas DC-3, which has been standard for several years on domestic airlines, has been estimated at about 36c. a mile or 1.7c. per seat-mile. The 36-seat Curtiss *Commando*, now in production for the armed services, has an indicated *direct* flight cost of 50c. a mile, or about 1.4c. per seat-mile.

Lowering the direct flying cost with a corresponding increase in load permitting a greater spread of overhead expense offers reason to believe that airline

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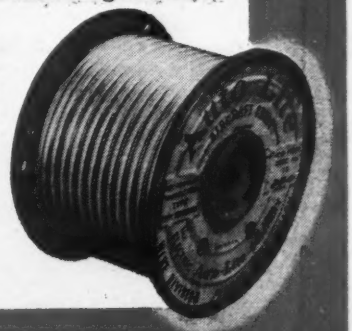

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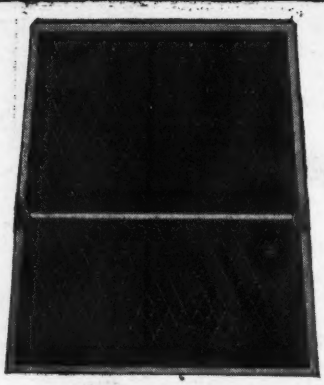

Typical AAF Airplane Engine Intake Filters as used on American bombers

AAF ENGINE INTAKE FILTERS MAKE DOUBLY SURE HIS STICK NEVER LETS HIM DOWN

Riding high in the clouds—alert to any enemy interceptor that might make a lucky hit on one of the precious fortresses he's assigned to protect—an American fighter pilot deserves to know that his ship will respond when he's forced to turn, twist and dodge to escape a withering enemy fire.

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fares of the future may be more nearly competitive with railroad coach rates. This in itself should give postwar transport aviation a large share of the railroad coach traffic on the longer hauls.

As for Pullman traffic, over distances of 200 mi. it is reasonable to believe that the airlines will absorb a major portion of it. In addition, it has already been demonstrated that the airlines not only draw their traffic from existing surface media but generate traffic of their own. This is easy to understand when it is remembered that the speed of air transportation permits many more and longer trips to be taken that would otherwise be impossible because of the limitations of time.

But again, in an attempt to be realistic let us assume that all of the railroad passenger traffic of 1941, both coach and Pullman, went to the airlines after the war. The result? Less than 1,600 planes of the *Commando* type could adequately carry the load.

Another important potential of aviation's postwar development is in transoceanic and foreign passenger transport. The United States had made a good beginning before the war, but in terms of numbers of passengers and tonnage of mail or express, it was relatively insignificant. The experience gained during the war by the Army, Navy, and air transport companies operating under contract with the services will, when the story can be told, amaze most Americans. I have complete confidence that postwar growth in our overseas air transport operations will be significant, but here again realism requires that we consider the limiting factors.

Transocean Figures

In the twelve months ending June 30, 1938, a total of 291,000 passengers arrived in the United States from Europe, while 276,000 made the opposite journey. Of those numbers, 74,000 and 55,000, respectively, were in the first and cabin classes. Only 34 planes of the size of the Martin *Mars* would be needed to handle the latter volume of traffic. Here again, the speed of air transportation overseas will probably engender an entirely new class of traffic, but the element of cost will continue to be a limiting factor.

In the direction of South America and the Orient, air transportation will have a greater competitive advantage because of the time element and the fact that surface transportation has not been developed to the same degree on those routes that it has on the more heavily traveled Atlantic.

Next, let us consider the probable future of air cargo development. In such consideration we must make a distinction between domestic and overseas, as well as between freight or commodity cargo and express. Here, too, the public has been built up to an expectation that cannot be supported by realities.

Taking the domestic situation first, we must understand that we have in this country a highly developed system of rail and motor carriers. Prewar, the air express cost to the shipper was approximately 60c. per ton-mile, rail express 15c., motor freight approximately 2c., and rail freight 1c. Obviously, the air express rate will be substantially reduced, even assuming no improvement in present equipment.

Nevertheless, the disparity in cost is such that there is little prospect for postwar domestic air freight development, except in those few portions of our country where surface transportation does not exist. At some time in the unpredictable future when new and revolutionary types of aircraft and motive power have been developed, this situation may be changed. But such a change is certainly not on the horizon as yet.

In another phase of air express, however, the domestic prospect is far more encouraging. Enormous progress, for example, has been made in packaging

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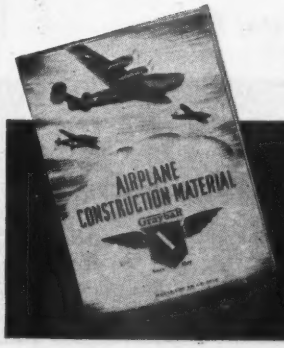

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and dehydration of foodstuffs. These plus luxury food items such as Maine lobsters served in the Middle West within 36 hr. of their removal from the sea, California flowers sold in New York within 24 hr. of cutting, periodicals and other high value specialty goods will, I believe, provide a substantial market for aircraft utilization in continental United States after the war.

In the field of overseas cargo transport, the prospect is less promising. A typical present-day transatlantic aircraft, for example, carries roughly 18,000 lb. of fuel for 4,000 lb. pay load. It has been estimated that between San Francisco and Australia, the number of tankers required to carry the gasoline for refueling would be about three times the number of cargo vessels required to transport the cargo itself.

While it is difficult to secure accurate average ton-mile ship rates, it has been estimated that they are but a few mils. Even assuming that aircraft cargo rates could be reduced to 10c. per ton-mile, the conclusion is inescapable that aircraft could secure only an insignificant portion of the traffic.

There is a bright side to this picture, however, that should not be underesti-mated. Vast areas of the earth's surface, both on this continent and in Africa and Asia, still have no surface transportation and usable roads are few and far between. Despite the existence of vast stores of natural resources in these areas, it is uneconomic to build either railways or, in many cases, good roadways. The flexibility of air transportation, requiring as it does only terminal points with no intermediate connections, makes it the logical means for the development of these areas.

Even before the war we had, in Alaska and in Central America, ample demonstration of the reliability, efficiency, and economy of that type of operation. The contribution to the world's standard of living, offered through opening of such additional areas and resources, is intriguing.

Now, let us examine the probable effects of the estimated development of the aviation manufacturing industry of our country. First, some figures on its prewar size and war growth:

In 1939, the aviation manufacturing industry in the United States employed approximately 70,000 people and produced up to an annual value of approximately $280,000,000. According to present forecasts, the industry will reach its peak during this year, when it will employ more than 2,200,000 people. And the annual value of its production will approximate $20,000,000,000.

Peak employment will be over 30 times the prewar figure, while the annual value of the product will have increased more than 100 times. Since the beginning of the war, more than $3,000,000,000 has been invested in additional facilities for the industry. It is unnecessary to point out that the decisions which must be made as to the disposition and utilization of those facilities and of that labor force will have a profound effect on our nation's postwar economy.

Estimates Optimistic

Competent authorities, after taking into consideration the potentials covered in this discussion in the several categories of aircraft utilization, have estimated the postwar demand for aviation products in terms of dollars. A review of their work leads to the belief that the result is on the optimistic side. In the field of military aviation they estimate that the United States, including participation in an international police force, will maintain a standing air force of approximately 24,000 planes requiring an annual replacement of approximately 6,000.

In addition, our aircraft manufacturing industry will unquestionably supply a portion of the military aircraft for non-industrial countries such as China and Turkey and our South American

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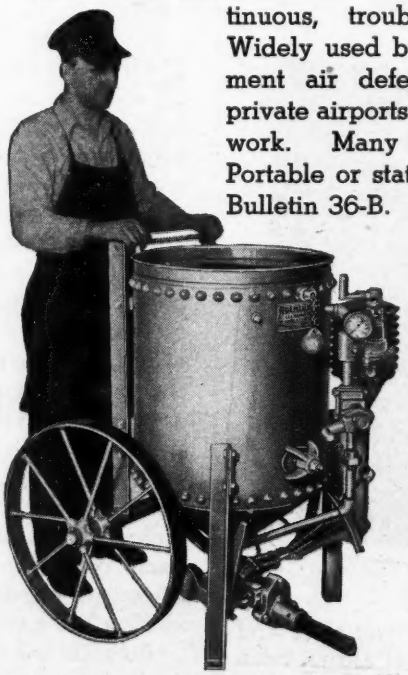

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neighbors. In terms of dollars, this combined market is estimated to equal about $1,200,000,000.

In the commercial field of air transportation, excluding cargo but including both domestic and overseas air transport demand, a total annual market of approximately $600,000,000 is estimated. In the cargo field—domestic and foreign—and for the period under discussion here, it is figured that there will be an annual market of approximately $1,500,000,000. The same authority has estimated for the private aircraft field an annual market of approximately $200,000,000, including domestic and foreign demand.

We have, therefore, a potential market for an annual output of this industry totaling approximately $3,500,000,000 annually, or approximately 10 percent of the peak output. With respect to the labor force, an equal percentage of the peak is estimated to be adequate to meet the postwar requirements of the industry, which would mean a total postwar employment of from 275,000 to 300,000.

The resulting adjustment, with all that it connotes, is too far-reaching to be exclusively a problem of the aircraft industry—it is a national problem. It will be solved because it must be solved. But it will take the highest order of cooperation between the public, government, and the industry to achieve that solution.

Beam in Termination

(*Continued from page* 123)

nce Co.; Donald Nelson, chief of the WPB; and John L. Sullivan, assistant secretary of the Treasury, who is reported to be the "nearest thing to a New Dealer" in the group.

Problems of contract termination are as much those of the contractor as of the government services. The blueprint of termination, as has been pointed out, must evolve to a certain extent out of experience. None of the termination clauses used by the various procurement agencies have indicated to what extent certain controversial items of cost will be allowed, such as special obsolescence resulting from cessation of war production.

There seems to be no sound reason why the contractor should not be repaid for special facilities which he acquired only for war output when these facilities are of no further use to him in commercial operations. Amortization of special facilities is recognized for tax purposes and renegotiation. Interest charges incurred in war production also seems a legitimate cost. Nor is there any termination provision for separation or dismissal pay or the costs of reconversion arising out of war production.

The prudent course for the war contractor is to set up these debatable costs in his accounts as he does all the rest. Then these costs can be promptly determined if the data is needed later. Present policies may be changed. Some of them probably will be.

It is also true that the aviation industry can speed settlements itself by adhering strictly to established production controls. It has taken contractors an average of 17 weeks to present their claims for termination settlement. This period could be cut by following the Controlled Materials Plan to the letter.

It is well known that war industries generally have inventories in excess of materials permitted under CMP. The Truman Committee has made public WPB figures showing huge amounts of excess critical material such as carbon steel, alloy steel, copper, and aluminum held by industry. These materials are no longer as scarce as they were even three months ago. Thus there is no excuse, in the opinion of procurement officials, for such large backlogs of raw materials, semi-finished materials, and parts.

The aircraft industry should heed the warning now that consideration is being given in procurement—and even in Congressional circles—to proposals to disallow any payments for materials in ex-

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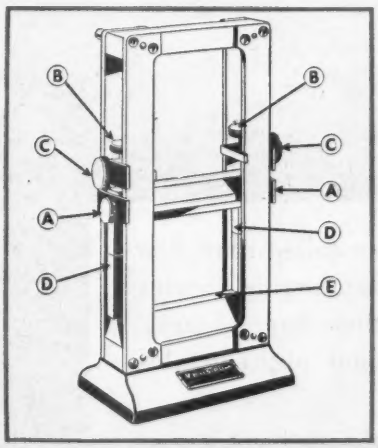

IT IS EASY TO ADJUST

To adjust the Ellstrom gage you merely follow the instructions listed below:

The two screws, A, on upper parallel bar have been carefully adjusted and need not be touched. In raising or lowering the bar loosen only screws C, then place fingers on screws A, and move bar upward or downward as the case may be, but without turning the screws.

Allow room to place the gage blocks on lower parallel between the posts of the gage. Then lower bar until its surfaces and those of the blocks fit snugly without any forcing. Tighten Screw C lightly and evenly. Screws B are then used to apply slight pressure in making final adjustment.

A film of rust-proof oil has been applied to the entire gage, and can be removed with a clean cloth or if necessary a little naphtha. D gage blocks E stationary parallel.

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cess of those permitted under CMP. Indeed, the War Department has been trying for the last year and a half to establish a policy whereby it would not pay for excess inventory.

Smart aircraft executives know that there is going to be an argument after the war about "unreasonable" excess inventories. The thing for each company to do is to set up a termination division directly under, and responsible to, the company president—then have this division everlastingly watch the excess materials situation in every plant department.

Tax Policies

(*Continued from page* 193)

prices are also considered proper claims for deduction from wartime income. Inventory losses resulting from the obsolescence of wartime inventories presents a situation which remains unclear. The Treasury sums this one up by saying: ". . . the case against deducting these charges from wartime income is as strong as the case for it."

Obsolescence of facilities promises to be a real problem. The test appears to be whether this represents a cost of producing war revenues or a capital loss. The question further presents itself that if these are costs which are properly deductible from war revenues, should not war revenues be increased by the gain in postwar profits resulting from the introduction and use of new techniques and products? No clear-cut answer appears at hand.

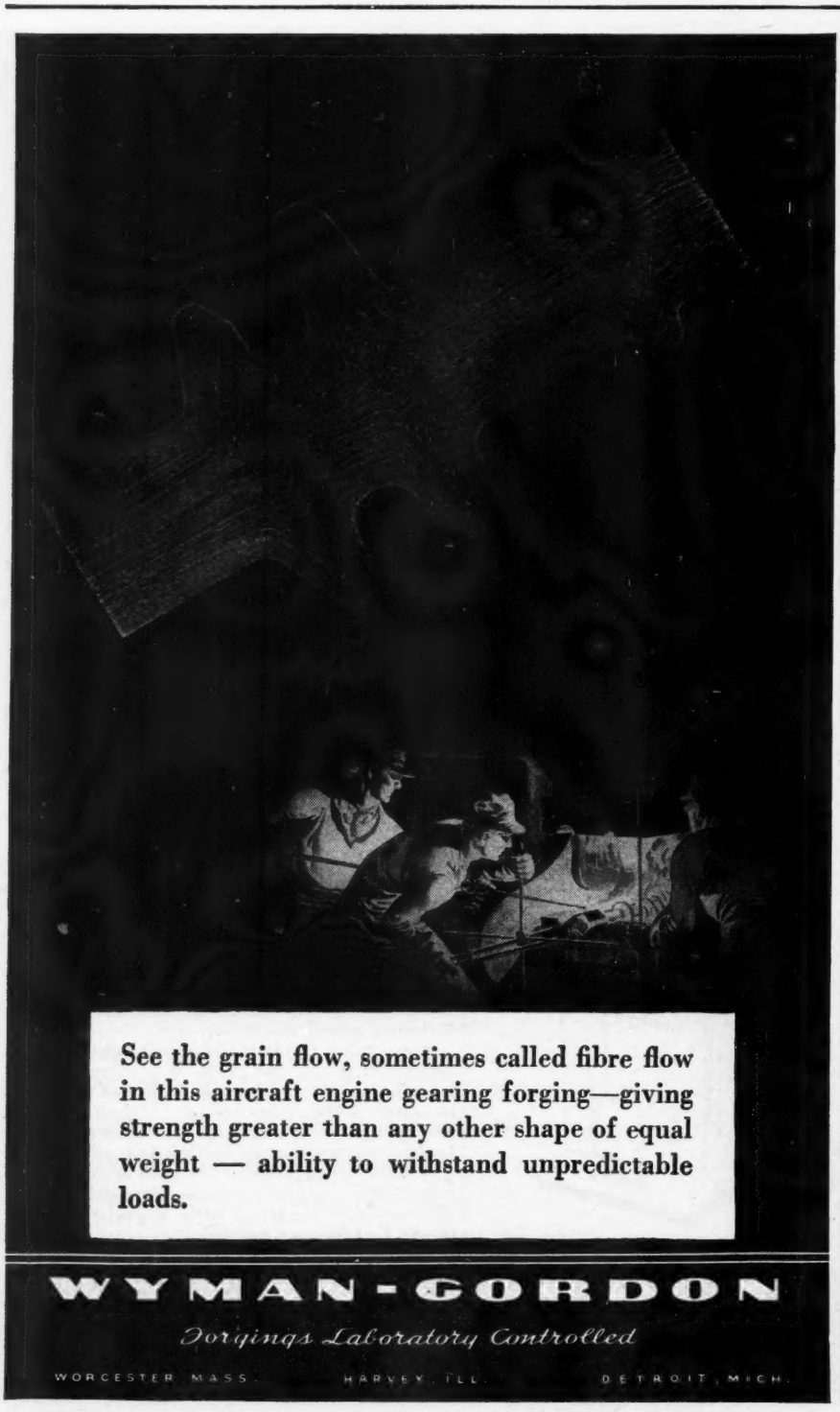
Expenditures for the development of new products and markets may be necessitated by the saturation of future markets with surplus war products. In this respect, expenditures for the development of new products are treated as expenses in the years when made and recovered from the consumers of the new product.

Considerable discussion is centered around the carry-back provisions of the tax law and the hopes it holds for the alleviation of postwar reconversion problems.* The Treasury presents some formidable tables which purport to show the adequacy of reserves in American industry. They are very much on the same nature as that presented in the work of the Federal Reserve Board and the SEC, and no useful purposes would be served by a detailed analysis.

It may be of interest, however, to note the Treasury's estimates of the effect of the carry-back tax provisions on a number of selected aircraft companies. Details are reproduced in Table II. Individual companies are not identified by name, since the form in which the data is presented makes this difficult. Of course, in the original source material many other industrial companies are shown and similarly presented.

The tendency of many observers is to ignore the tax elements because of their surrounding complexity. This cannot be done in the aircraft industry. This is one of the major intangibles which are now helping to shape the future pattern of the industry.

* Discussed in detail in Favoring Factor for Aircraft Investments, p. 173, Oct. 194 AVIATION.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Precomputed Sunline

(*Continued from page* 231)

through point *B*, as shown in our figure. It is also a simple matter to precompute, and construct a curve of, the altitudes as they would be observed by a person located at point *B*, for a few hours before and after the estimated time of arrival. The curve of altitude vs. G.C.T. is shown in Fig. 2.

Now let us assume that 3 hr. before the E.T.A. (estimated time of arrival) you start to observe the altitude of the sun, at 20-min. intervals, and that a plot of these points is represented by the dashed line *a-a* in Fig. 2.

By 0800 G.C.T. it is easy to see that

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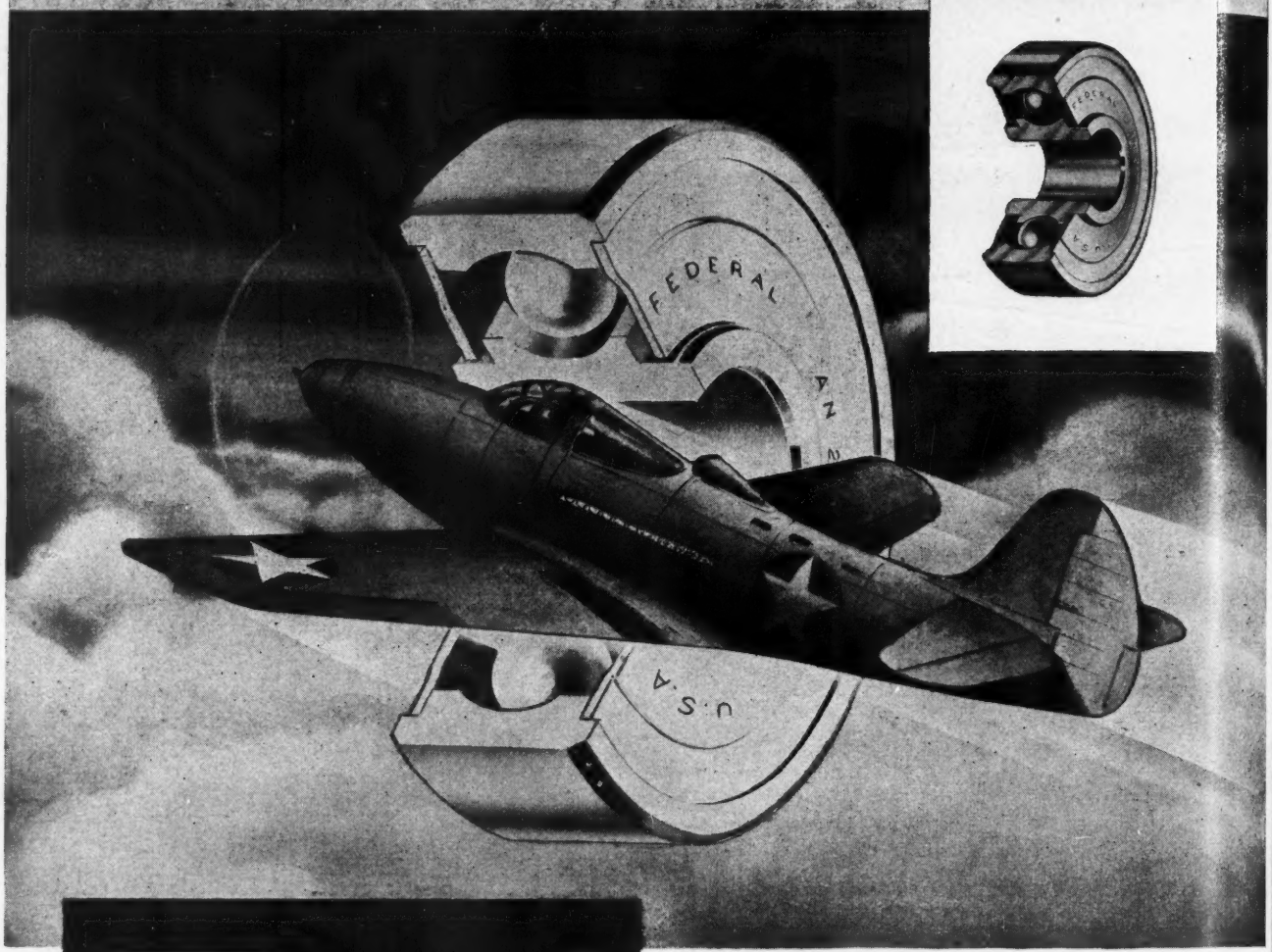

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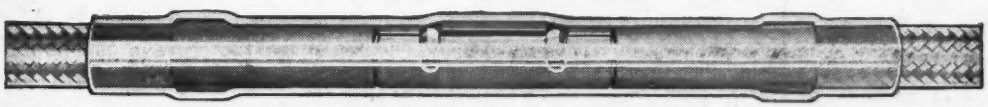

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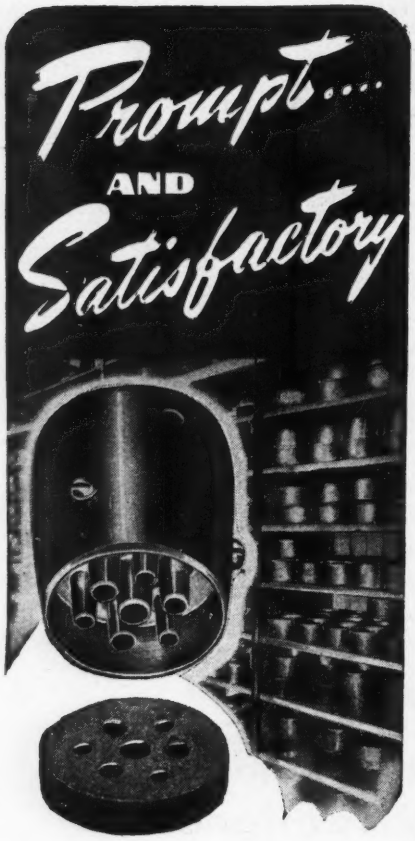

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the line *a-a*, if projected, will intersect the line of precomputed altitudes at a G.C.T. sooner than expected. This would indicate that either you had made an error, on the high side, in determining your E.T.A., or that you are north of the track and thus will arrive at a line of equal altitude sooner than you would were you on track. You should hold your compass heading until the line *a-a* does intersect the precomputed curve. If you are on track, and simply made an error in the E.T.A., the island will be right below you. But if you are north of the track—as would be logical to assume if there is no island directly below you at the time the observed curve, *a-a*, intersects the precomputed curve—then you should sketch in the line of equal altitude through point *B*, for this time, and immediately alter your compass heading to make good a track towards point *B* along this line.

On the other hand, if the plot of the observed points is represented by the dashed line *b-b* in Fig. 2, it would be logical to assume you are south of the track, and you should alter your compass heading accordingly.

But if the plot of observed points *does* intersect the precomputed curve at the E.T.A., and still there is no island to be seen below, then your guess as to which side of the track you are on is as good as anyone else's. Thus, if you are able to determine ahead of time that the observed plot will intersect the precomputed curve at, or near, the E.T.A., it is best to alter the compass heading, towards the azimuth line, an hour or so before the E.T.A., in order to be sure later of which way to turn. If the azimuth and track directions happen to be the same value, then it makes no difference to which side of the track you make the known error.

It might be argued that the E.T.A. may have been so much in error that its reference to the intersection of the precomputed and observed curves may cause you to turn the wrong way. In other words, if the actual time of a beam arrival occurred at a point such as *D*, in Fig. 2, but the E.T.A. was at point *E*, and if the plot of observed points happened to be a curve such as *a-a*, then you would normally turn in the wrong direction. But, this need not be serious if you continue to observe carefully the resulting shape and tendency of the plot of observed points after the turn has been made.

If you had concluded, from a plot such as *a-a*, that you were north of your intended track, and had consequently turned south, and if you actually were north, then the resulting plot of observed points would look like the curve marked *"I"* in Fig. 3. In this case the observed altitude would, at first, be equal to that of the precomputed, but when the turn south was

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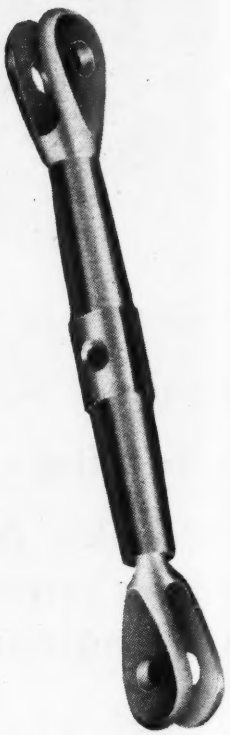

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He could have fooled a lot more people for a lot longer time, if he had only tried the trick of nursing along old truths—now turned into fallacies—but still adhered to by the unthinking majority.

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....Recourse to arc welding has filled the seven seas with them.

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"You can't arc weld high-temperature, high-pressure piping" . . . . . .

....The one safe way is through recourse to arc welding.

FLOPPED FACT 3:
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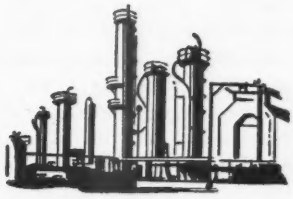

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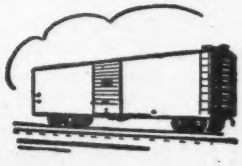

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made, towards *B* along the line of equal altitude, the observed altitude would be less for a while, and finally, when *B* was reached, the observed and precomputed altitudes would be equal again.

On the other hand, if, due to extreme error in E.T.A., you thought you were north, and so turned south, but actually you were south, and thus headed the wrong way, along a line of equal altitude away from *B*, then the resulting plot of observed points would occur as shown by the curve marked "2" in Fig. 3. This curve would have the tendency to get farther and farther away from the precomputed curve. In such a case you would naturally alter your compass heading so as to reverse your track by 180 deg.

In the same way, if you have concluded, from a plot such as *b-b*, that you are south of your intended track, and have consequently turned north, and if you actually were south, then the resulting plot of observed points would look like the curve marked "3" in Fig. 3.

The only remaining case would be as follows: If you thought you were south, and so headed north, but you actually were north, the plot of observed points would look like the curve marked "4" in Fig. 3. Just as in curve "2" the observed altitudes grow progressively greater than the corresponding precomputed values, so in curve "4" the observed altitudes grow progressively less than the precomputed.

Factors Summarized

It must be remembered that the example presented above is a particular case, and the ideas involved, rather than the rules, should be remembered.

A brief summary of these ideas is as follows: Using the latitude and longitude of your point of destination, make a plot of precomputed altitude vs. G.C.T. for a few hours before and after your latest and most accurate estimated time of arrival. Also, draw in lines of equal altitude, for these times, on your chart. Then plot the observed altitudes and if, when this observed curve intersects the precomputed curve, you do not find the point of destination below you, then decide which side of your intended track you are on by noting the relation between the G.C.T. of this point of intersection and the E.T.A.

Your decision will naturally depend upon the angle between the intended track line and the line of equal altitude through the point of destination at that time. After you have decided which way to turn along the line of equal altitude, check your decision further by observing the shape and tendency of the resulting observed plot as compared to that of the precomputed curve. This should tell you whether or not you are headed in the right direction along the line of equal altitude.

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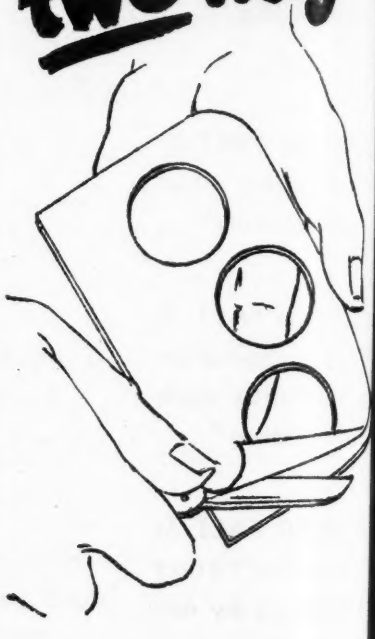

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(*Continued from page* 242)

ould allow loading of bulkier packges than is now possible. Anticipated payload for the 3,450 mi. range is set t 16,430 lb., for 2,100 mi. 32,680 lb., nd for 1,000 mi. 47,880 lb.

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High speed, transport	425 mph. at 16,000 ft.
High speed bomber	400 mph. at 16,000 ft.
Climb, at sea level	1,500 ft. per min.
Take-off run	1,950 ft.
Distance to clear 50-ft. obstacle	3,000 ft.

Postwar Airports

(*Continued from page* 121)

oment of the rolling resistance around e center of gravity, as shown in Fig. 5. To counteract this tendency it would necessary to set the wheels at an ngle of yaw slightly in excess of the ngle of drift. With such an undercarage, therefore, the degree to which the lot would encounter the present probms of drift landings would be dermined solely by the extent of his ror in setting the yaw of the main heels and would be independent of e extent of drift.

Objective of yawing those wheels hich are connected to the rudder pedals th respect to these pedals—at the me time that the main wheels are wed with respect to the airplane es—is to avoid the neutral position of e rudder, i.e., that causing no change heading, from altering with degree yaw. Experience might show that s is unnecessary and, if so, the differtial gearing connecting the front and r wheels could be eliminated. However, if this were done the rudder pedals uld have to be so geared to the steerle wheels that the latter could be wed to a greater degree than any posle yaw of the main wheels.

Steering control *A* might also be minated, with its function automatily performed by providing freely stered wheels. In this case the path uld be wholly controlled by aerodymic forces as in some of the earlier rplanes in which all wheels were inpendently castered. The path would ways be related to the airplane headg by the requirement that there be component of the aerodynamic forces

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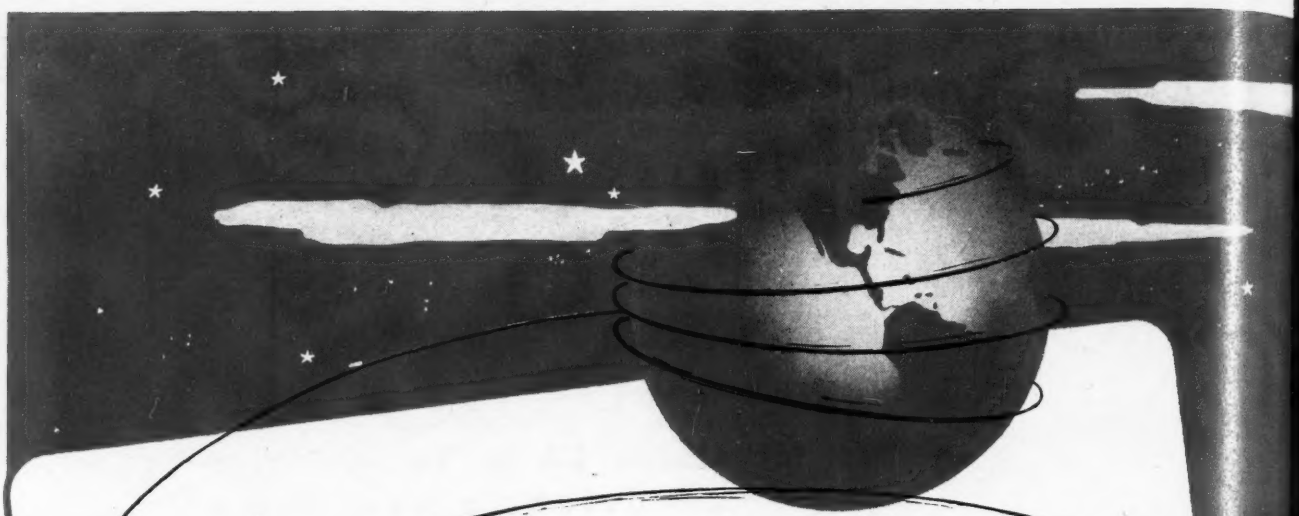

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Post-war aviation will usher in an age of family planes, heliocopters, freighters and business planes in designs passing all layman conception.

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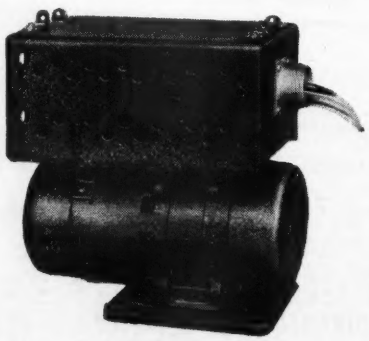

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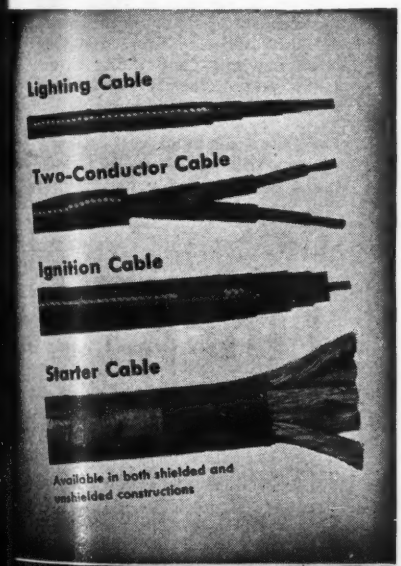

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perpendicular to the path. However, the heading of the airplane would be positively controlled by the reaction of the wheels with the ground, whereas in these earlier planes with independently castered wheels the heading also was controllable only by aerodynamic forces.

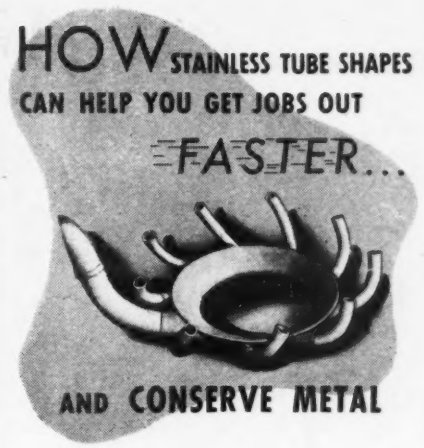
The maximum sideloads which could be imposed on the wheels with this arrangement would be those required in drift landings to give them (not the airplane) the necessary angular acceleration around their caster axes, also in taxiing those necessary to rotate the airplane around its normal axis (not those necessary to alter the direction of motion).

Sideloads on the wheels necessary to accelerate them around their caster axes on first contact with the ground would affect the performance during this period. If the front wheels touched first, there would be some tendency to increase the plane's initial yaw relative to the runway. This would have to be stopped by applying opposite rudder, which would be a natural move by the pilot in any event.

Since such a landing would be at a relatively high speed, the amount of drift would be relatively small and the rudder relatively powerful, and hence the amount of rudder needed would probably be small. If the rear wheels touched first, the moment of this force would tend to decrease the yaw of the airplane relative to the runway. In neither case would the side forces on the wheels be sufficient to materially alter the path.

It is evident that with a type of gear which requires that the direction of the resultant of all aerodynamic forces on the airplane coincide with its direction of motion it would be impossible to maintain a straight path not aligned with the wind unless some propeller thrust were available, since a component of the thrust perpendicular to the path would be required to cancel out the component of the wind force perpendicular to the path. It would also be impossible to maintain a straight course on a sloping terrain except in the direction of the slope.

This difficulty could be overcome by making either or both of the following changes: First, the maximum angle of caster of the main wheels could be limited. If this were done the performance would become identical to the performance with fixed main wheels when the maximum angle was reached. If this angle exceeded the maximum angle of drift in any landing, the landing performance would be unchanged and the maximum sideloads on the wheels in taxiing would be only those imposed by the crosswind plus those that might be required to change the path into the wind. The latter would be small as this



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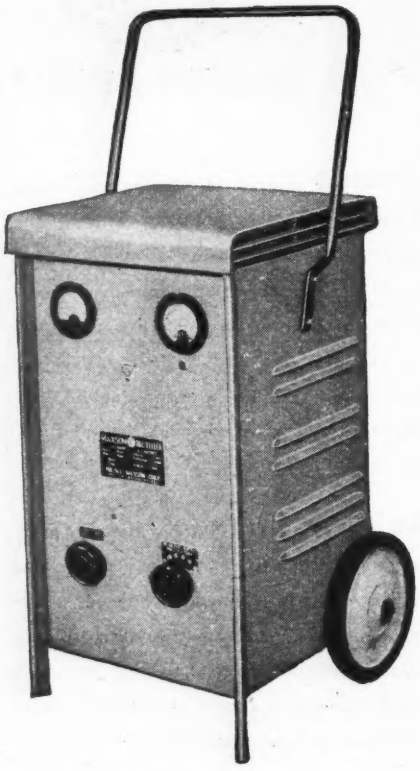

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condition would only arise at low speeds.

Second, some resistance to castering could be provided either by springs or by caster design. Some spring resistance would be required in any event to return the wheels to neutral in the air to make certain that they would not be yawed in the wrong direction at the instant of runway contact. This resistance could, if desirable, be made to vary with the degree of yaw.

The simplicity of this type (as shown in Fig. 6) recommends it particularly for modifications of existing designs. It will also be apparent from the sketch that many airplanes now in service could be readily modified to this form.

With a resistance to yaw of the wheels relative to the airplane axes, the performance would be somewhat altered from that previously described. In this case the path would not be that which would give no component of the aerodynamic force perpendicular thereto but one in which this component would be equal to the sideloads on the wheels as determined by the degree of yaw and the coefficient of the yaw restraining force. Also, in first contact with the runway, the moment tending to yaw the airplane relative to the runway due to the side force necessary for the acceleration of the wheels around their caster axes would be increased by their caster restraining moment.

In the case of landing with rear wheels contacting first, this would be immaterial. But for landings in which the front wheels contacted first, it would be necessary that the caster restraining force be kept sufficiently low so that the total yawing moment on the airplane due to the wheels would not exceed the value which could be fully compensated by the rudder.

To obtain the directional stability of the so-called tricycle undercarriage when all wheels are on the ground it is only necessary that the moment around the center of gravity due to wheel sideloads resulting from wheel yaw be greater for the rear wheels than for the front wheels when no direct connection is provided between front and rear wheels. If such a direct connection is made, it is only necessary that it be such that when the wheels are yawed the rear wheels will assume a greater degree of yaw than the front wheels.

The desirable anti-ballooning characteristic of the tricycle gear can be obtained, of course, by so designing the undercarriage that the rear wheels contact the runway first under any probable landing conditions.

It is worthy of note that both of these characteristics can be obtained with one wheel back and two wheels forward. This arrangement of wheels was used in the Waterman tailless airplane in its initial form and later was

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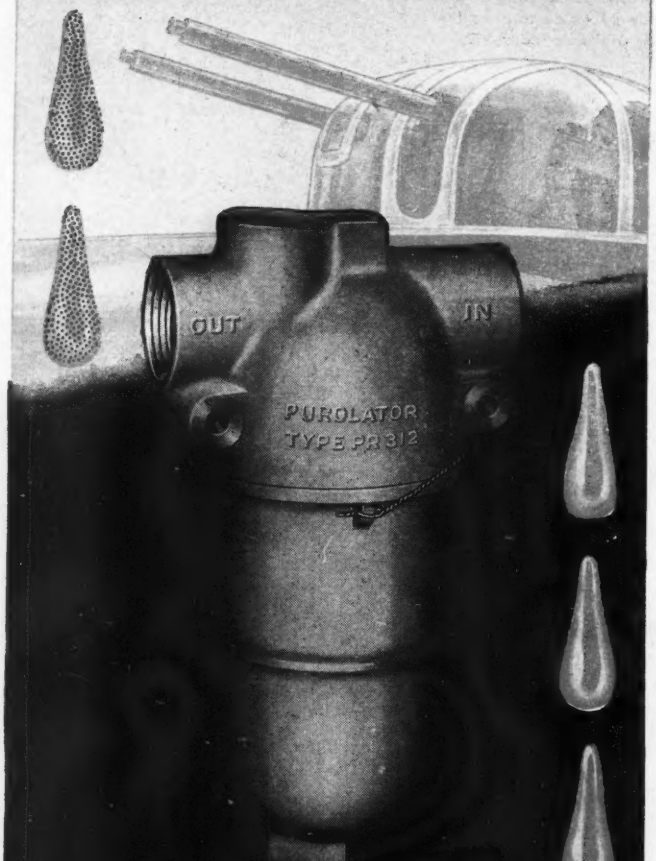

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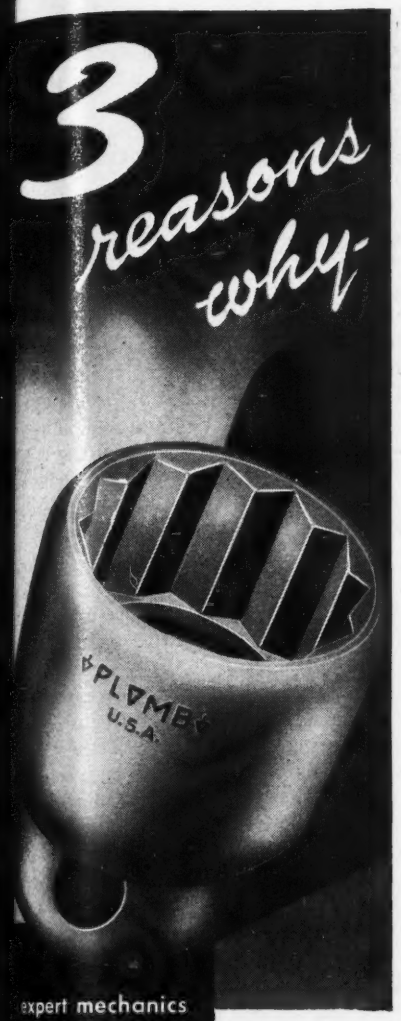

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used in the Huff tailless airplane. One problem in such designs—and a simple solution—can be pointed out. In order to provide sufficient roll stability in the undercarriage to take care of gusts, it is necessary that the load carried by the two front wheels be not too light. These wheels should also be far enough forward to prevent nose-over with full application of the brakes. These combined requirements can only be met by placing the rear wheel well behind the center of gravity, and this introduces the problem of getting the nose up on takeoff.

A solution, although not the only one, is that of providing a longer taxi spring in the front struts than is provided in the rear strut. If this is done, the plane will automatically nose up as its weight is taken off the wheels and placed on the wings. This was done in the Huff plane, and in its short trials it proved to be satisfactory. In fact, too much differential was provided and the pilot found it necessary to hold the nose down until sufficient speed had been reached for takeoff. Placing the two wheels forward has the distinct advantage of reducing the liability of nose-over and of permitting faster turns on the ground.

The author does not suggest the foregoing types as the only, or even the best, solutions to the problem of constructing our airplanes so that they may be operated from single-flight strips by novice pilots. They are presented only to indicate that a little study given to this problem by our manufacturers might very well open up entirely new possibilities in aerial transportation.

Returning now to airports, it is suggested that perhaps we have not fully realized the advantages of the single runway airport. In constructing airports today it is not only necessary to find a suitable piece of ground measuring about a mile square and convenient to transportation, but it is also necessary to find one which will permit a 20-to-1 approach at each end of each runway. How much simpler the task would be if only two approaches were required and the site required was only 1 mi. by 500 ft., instead of 1 mi. sq., can well be imagined.

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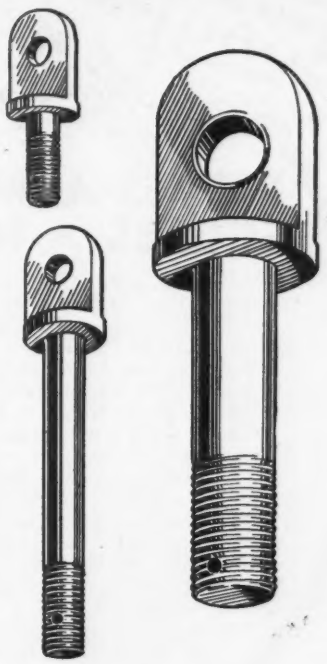
For private flying, the provision of single landing strips, and the construction of airplanes that can be safely landed on them by a relatively unskilled



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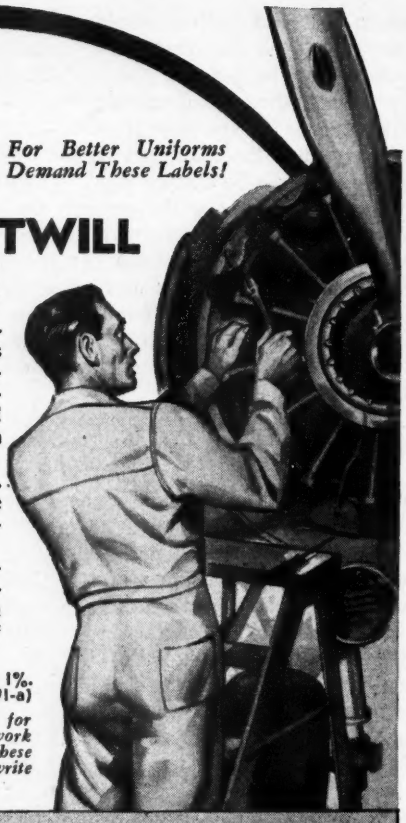

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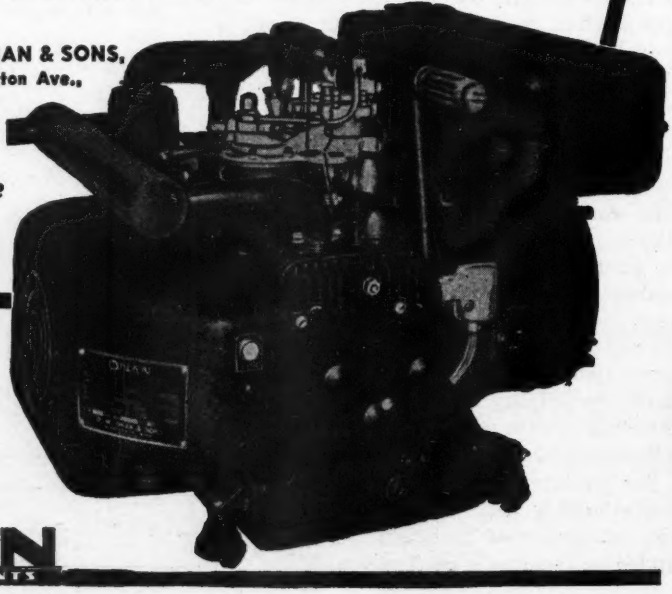

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pilot, is essential, in the opinion of th
author, if we are to enjoy the growt
in private flying to which we all loo
forward. The aerial highway for th
private pilot is for the most part mad
up of landing facilities, at not too in
frequent intervals, where he may com
down if he is lost, short on fuel, o
caught in bad weather.

Landing facilities near his home, i
parks, beside fishing streams, at sum
mer resorts, and near any other plac
he might care to visit will be require
if he is to find his airplane worth i
keep. The possibilities of providing th
large number of landing facilities h
will need, if they must be all-way fields
is infinitely less than the possibility o
providing them if a single strip is ad
quate for his purpose.

In surveys, conducted by the CAA i
1940, of past private airplane owner
and of students who had given up flyin
before securing private pilot certifi
cates, inaccessibility of airports w
given by both groups as the major re
son, next to cost, for giving up flyin
It is unlikely that many of these flye
lived in communities that did not hav
one or more airports, yet this was n
sufficient. An airport, even when it
reasonably close to the center of a com
munity, is not convenient to the res
dents on the opposite side of the com
munity, unless the community is sma

To be convenient to the owner, th
airport must be on his side of the cit
and this means that the city must
surrounded with airports if they are
be convenient to all. The probabili
that any community would be willing
provide such a large number of all w
fields for a few pilots is extremely r
mote. But simple landing strips a
jacent to all of the main highway
leading into the community could w
be afforded.

In addition to the greater access
bility which can be attained, there is
distinct advantage to be gained by th
substitution of numerous flight strip
for a few all-way fields in the matter
traffic congestion. If the postwar growt
of private flying does present a pro
lem of traffic congestion it will do
only at the airports. Vastly more ai
planes than anyone now anticipat
would be required before congestio
would appear elsewhere. Without an
increase in traffic congestion, each sing
flight strip could accommodate as man
airplanes as all-way airports limited
the use of one runway at any one tim

Also, single strips could accommoda
more airplanes than each of the run
ways on multiple parallel runway fiel
due to the fact that they would not
confronted with the problem of inte
fering traffic patterns. This is assumin
of course, that in the interests of ma
imum accessibility the landing strip

K+E

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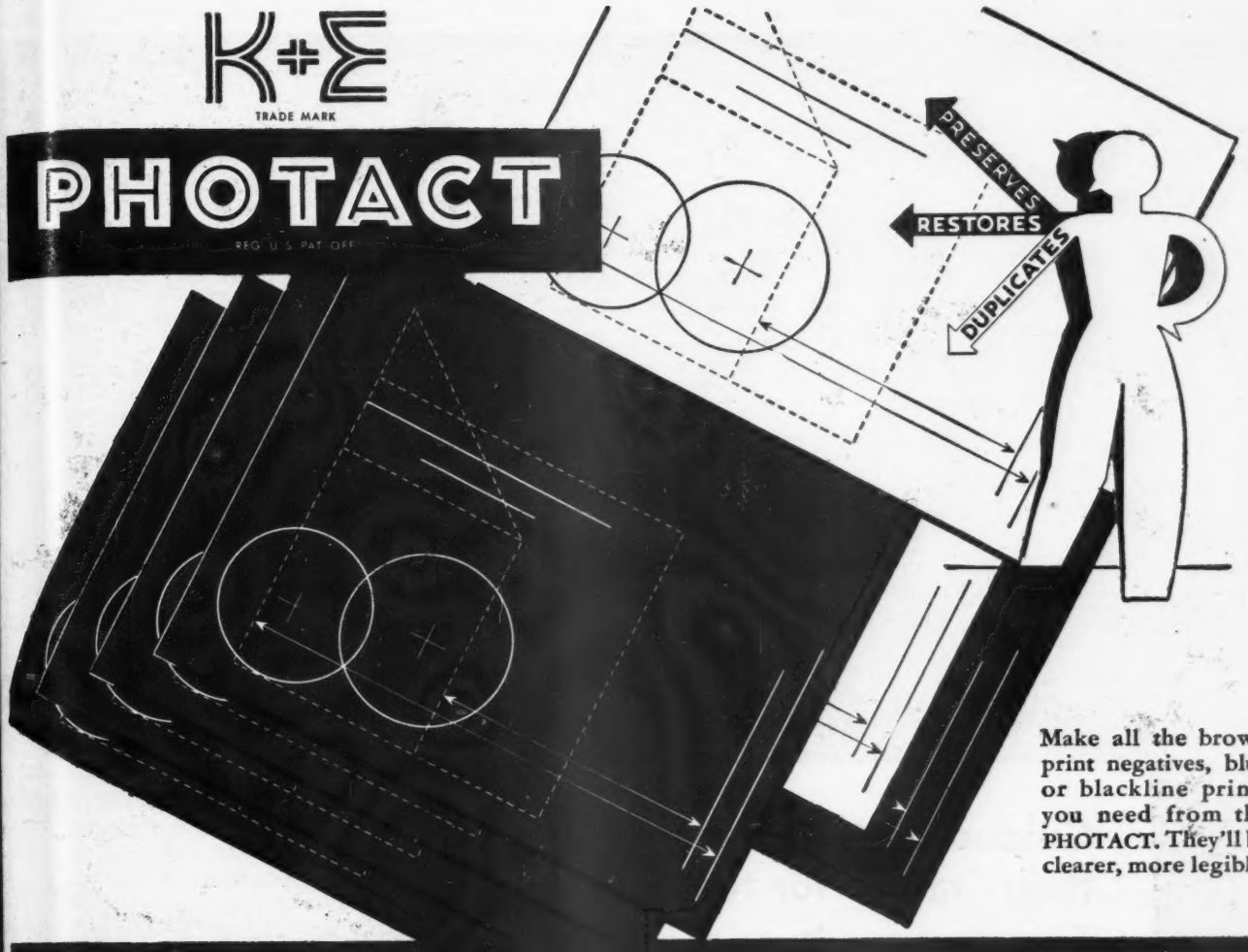

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would not be placed close together.

For the private pilot, a reduction in airport size materially greater than that indicated in the accompanying sketches would be in order. In a recent survey of private airplane manufacturers, the consensus was that a landing strip 3,000 ft. long and 200 ft. wide would be ample—some considering even this size much too large.

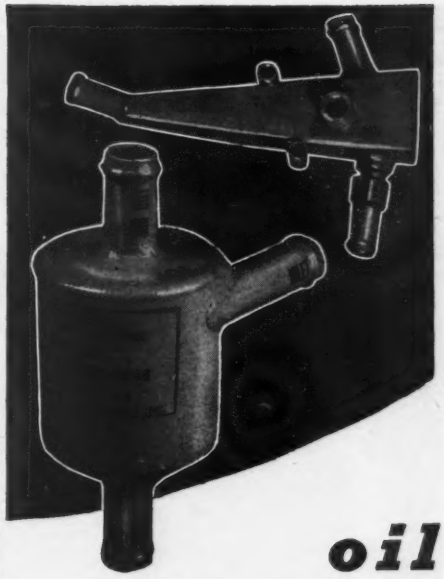
Such a strip would require only 14 acres. This length of runway being comparable to those provided on Class 2 airports (2,500 to 3,500 ft.) a comparison with Class 2 airports is in order. The *Airport Survey,* House Document 245, 76th Congress, 1st session, gives the average cost of Class 2 airports as $175,000, of which about ⅓ is cost of land and preparation of surface. The latter amounts to approximately $300 per acre, of which about $40 represents cost of land and $260 preparation of surface. Assuming the same cost for the landing strip, the cost of such strips would be $4,200.

From this document it can also be deduced that the cost of fencing, marking, and of a wind indicator for a Class 1 airport, averaging about 100 acres, is about $6,000. For the strip, one half of this amount, or $3,000, would appear to be ample for these items. This would bring the total cost of a 3,000 ft. strip to $7,200. The average cost of Class 1 airports providing 1,500 to 2,500 ft. runways is given in this document as $36,000, and as previously mentioned the average cost of Class 2 airports providing 2,500 to 3,500 ft. runways has been $175,000.

This figure of $7,200 does not include buildings but—and this is important—at least one of the larger oil companies has already indicated an interest in providing service stations at such landing strips whenever they become available. Their studies have included provision of facilities for minor mechanical service and facilities for serving lunches or meals. Some thought was also given to providing individual hangars. It is anticipated that such service stations can be made to pay by dividing their service between the highway and the landing strip.

Only those who have had the experience of operating a private airplane under prewar conditions can begin to appreciate what such service stations would mean to the growth of private flying, giving, as they would, service to the airplane comparable to the service they have been giving to the automobile.

Years ago, Col. Stedman Hanks started his advocacy of landing strips. We listened, looked at them through a conventional landing gear, found that they did not line up with our conception of cross wind landings, and put them aside. But today they are again under



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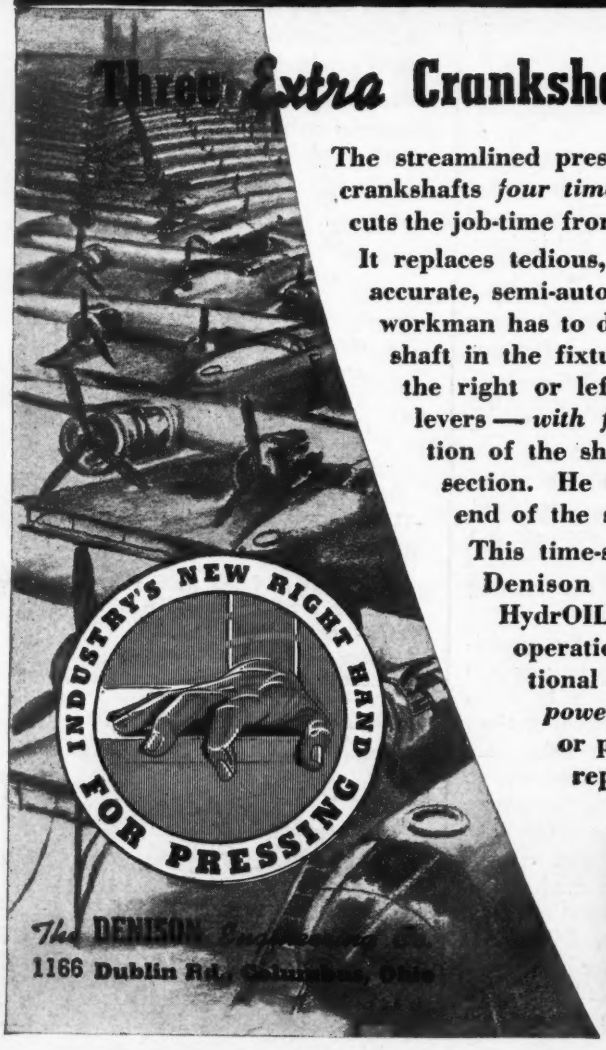

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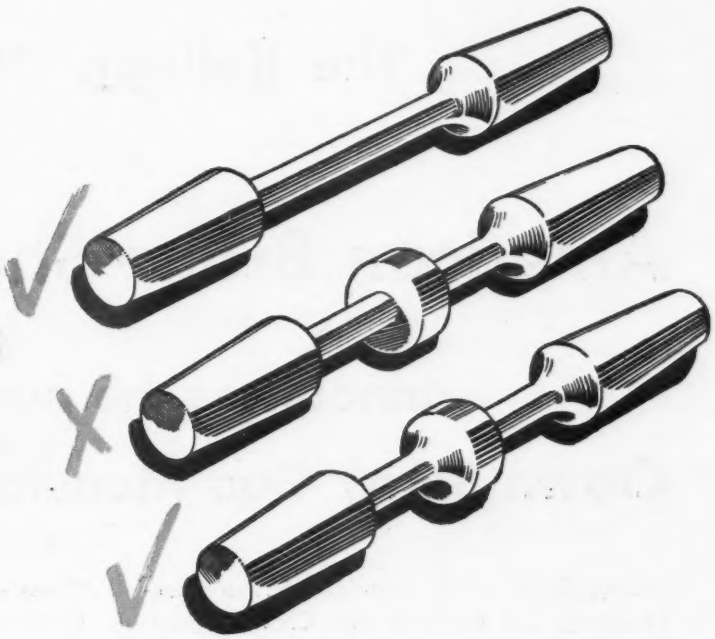

Magnesium alloys have good resistance to fatigue. Like other metals, however, they are sensitive to the effect of notches and other stress-raising factors. For example, the middle test bar shown above, with its sharp corners at the cast-on center ring, has only half the fatigue strength of its two neighbors.

What to do and mistakes to avoid are told in the new book, "Designing with Magnesium", just published by American Magnesium. Your designers should have this book for a guide in changing over to magnesium. Copies will be sent free to the men you name in your organization.

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Kellogg Division of American Brake Shoe Company has acquired the Crown Spray Gun Manufacturing Company of Los Angeles, California.

This adds to the Kellogg-American line of air compressors a complete range of spray equipment including guns, booths, exhaust fans and paint containers.

Kellogg also makes car lifts and high-speed car washers. With the purchase of Crown's production and research facilities, service in the fields where Kellogg-American is widely known and used will be expanded.

Products of the Crown plant, which will continue to be made at Los Angeles, will be distributed in the future under the name Kellogg-Crown. Each plant will benefit from the research and engineering divisions of both organizations, and from that of the American Brake Shoe group of technologists at Mahwah, New Jersey.

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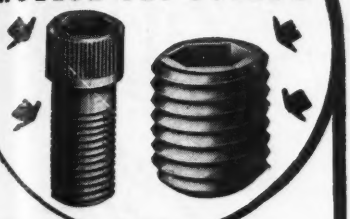

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consideration and with a good number of advocates.

However, many still consider them from the viewpoint of conventional, or at best tricycle undercarriages and still find difficulty in aligning them with the wheels of such undercarriages. They are people whose views on aviation subjects are sought and valued, hence their opinions can and will retard the acceptance of flight strips until they are convinced of their suitability. Most of these men are not interested in theories or in pretty pictures of what might be done. They will have to be shown—and the time to show them is now while airport expansion programs are in the making—not after the airports have been constructed.

Officers Get Bearings

(*Continued from page* 235)

own hoisting tripods by cutting down trees and lashing them together. In place of steel cables they use ropes and tree-trunks for levers. At one time some crashed P-47's and later three B-17's were sent to the airport for the cadets to re-build, as they may have to do overseas.

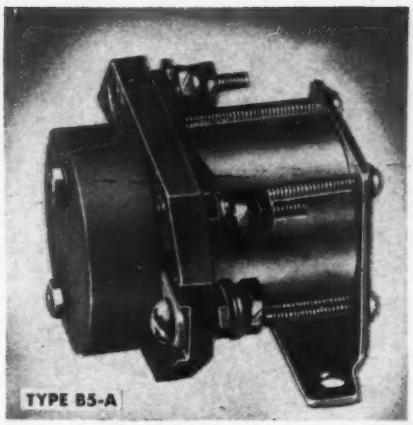
The Care of Firepower

The course in armament follows the same general lines as that in engineering. Cadets must have had two years of college training in engineering or the equivalent practical experience but need not have any previous knowledge of armament. They begin with the construction and operation of machine guns and small arms and continue through cannon, engineering physics, explosives and bomb racks, chemical warfare, gun sights, synchronizing, and power turrets.

Because of the complicated armament in a present-day bomber, armament cadets must study many of the same subjects as the engineers—electric wiring, for example, since the bomb racks are operated electrically; hydraulics of power turrets; and instrument maintenance of the automatic pilot.

In classrooms, of course, wiring and tubing cannot be arranged as in a plane, but mockups are provided until cadets can work on planes at the airport. In one small room, cadets test installations of automatic pilots on a jig which is shaped, balanced, and reacts like a plane. In other rooms are bomb racks and gun turrets. Study of turrets takes up a large part of the course, and cadets spend about one day working on each of six types of power turrets—Martin, Bendix upper and lower, Consolidated tail, and the new Sperry upper and ball.

The course in photography not only teaches cadets the science of picture taking but is continually adding to the



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Army's knowledge of it. The regular curriculum consists of such fundamentals as ground and aerial cameras, copying, projection printing, film processing, and portable laboratories. But since cadets may some day find themselves in battle without proper equipment, instructors are always experimenting with substitute methods for established procedures. For instance, making a camera with a cardboard box and a strip of celluloid pierced with a pinpoint is one improvisation. Instructors also show cadets how table salt can be used for potassium bromide in the developing solution and how G.I. soap serves for sodium carbonate. A good substitute for acetic acid solution, used in hypo to arrest development, is carbon dioxide, easily obtained from the engine exhaust of the mobile unit after it has been put through water.

Another Use for Sugar

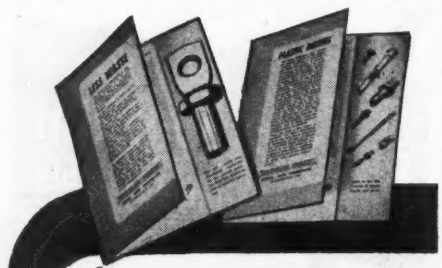
Trying to foresee and prepare for anything that could possibly go wrong, instructors also familiarize cadets with combat climate and geography. They teach them, for example, how granulated sugar can be used for sodium sulphate to keep film emulsion from melting in tropical areas, and how salt water can be substituted for fresh water and potassium bromide in developing solution.

One of the chief jobs of photographic officers is interpretation. Cadets are given a thorough training in printing and assembly of mosaics and in map reading and also in intelligence procedures and photo mission planning. Toward the end of the course they are taken on a 48-hr. trailer-field trip. They plan this mission, take a number of pictures of different spots from different angles, then develop, assemble, and read them. Later at the airport they practice aerial photography as well as the installation and maintenance of aerial cameras.

In order to cope with photo chemistry and mission planning, cadets are required to have completed two years of college and to have a knowledge of physics and chemistry. For the communications course, on the other hand, a college education is not considered so important as the possession of an amateur radio operator's license.

To become experts in radio maintenance and inspection, cadets study direct and alternating currents, transmitters and receivers, ultra high frequencies, radio compasses, and wiring. And they practice sending and receiving in Morse code, learn direction finding, radio bearings, position fixes, and blind landing procedure. Another part of the course is the study of telephone communication, including setting up portable switchboards out of doors.

In many of these subjects cadets are



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aught by civilian women called WIRE's women instructors in radio engineering). Although the instructors throughout the school can be either civilian engineers or limited service military personnel, women teach only in the communications course.

Into the middle of the old Yale campus have been brought a communications truck and the fuselage of a crashed B-25 in which cadets practice installing radio equipment at the same time that they are studying theory in the classroom. At the airport they become thoroughly initiated in the maintenance, installation, and inspection of radios on all types of planes.

From all four courses—maintenance, armament, photography, and communications—cadets are graduated as second lieutenants. For most of them, the next step will be overseas to one of the combat fronts, where they will direct the maintenance work of some 50 enlisted men and will have the sole responsibility of inspecting the equipment of their squadrons before they go into battle.

"Rough Engine" Cured

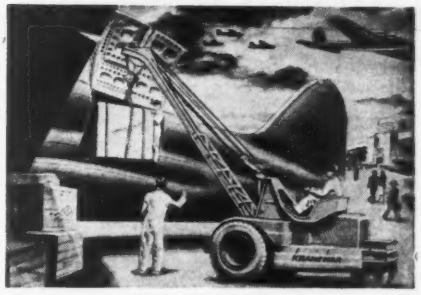
(*Continued from page* 211)

At the end of 25 hr. continuous running, the entire system was still functioning perfectly. After this test, the assembly was taken apart and carefully examined for traces of moisture. None whatever was found. Then water was purposely admitted to the reassembled system and the under water test resumed. In a short time it was re-examined and found to be perfectly dry, proving that the circulation of dry air, even when unaccompanied by engine heat, was capable of removing more moisture than would ever be present during operating conditions.

By special permission of the CAA, the system was installed on one engine of a transport plane flying regularly between Chicago and Seattle. After 500 hr. of flying through all conditions of weather, the interior was found to be entirely free of all impurities, such as moisture, de-icing fluid, or oil. Many flights had been made through rainstorms and fog without trouble developing. The ignition harness on the other engine, at the end of 250 hr. flying, had accumulated so much contaminating matter that it was necessary to drain the manifold and remove several leads for drying.

At the present time, the entire fleet of DC-3's of Northwest Airlines is fitted with this ignition harness. During over 5,000,000 engine-miles of flying there has not been a single case of trouble developing from harness contamination, nor has any moisture or other fluid been found in any part of the systems.

. . . when Peace cargo flies



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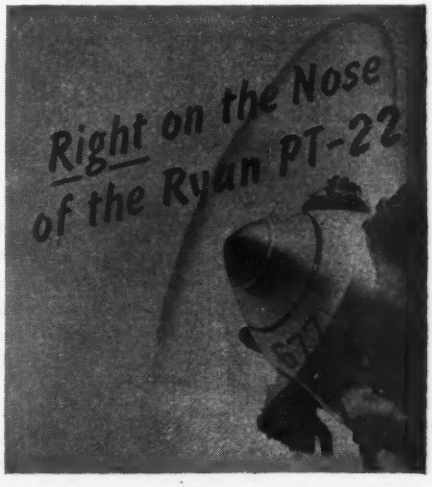

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Aircraft Hydraulics

(*Continued from page* 172)

the pressure setting of relief valves is generally about 20 percent above the highest operating pressure of the hydraulic system.

The main-pressure relief valve is generally placed in the line between the regulator valve and the accumulator, or just after the accumulator. This valve is used to protect the pump in case the pressure regulator malfunctions. Secondary or thermal relief valves are placed in all lines where fluid may be trapped under pressure. They relieve that pressure as it builds up through thermal expansion.

Aside from the standardization of functional requirements, relief valves have been completely standardized with respect to size, shape, mounting holes, port position, and port threads (see Fig. 3). This has made it possible to replace any relief valve in an airplane by another, regardless of who the manufacturer may be, without making any changes in mounting or tubing position.

Although the external envelope has been completely standardized, internal construction of relief valves in wide use today varies radically with each manufacturer. Generally speaking, however, they all use a poppet valve held on a seat by an adjustable loaded spring.

Fig. 4 shows the construction of the relief valve manufactured by the Kenyon Instrument Co. It can be seen that this valve consists of a housing made from aluminum alloy plate stock conforming to AN standard dimensions. A steel seat is inserted into this housing and held in place with a screw cap. Synthetic rubber seals on each end of the seat effectively isolate pressure into the seat. A steel poppet is placed into the seat, which is cross drilled and ported so that fluid can flow through the valve and around the neck of the poppet. Passages are provided to allow the oil to pass along the shank of the poppet so that full pressure is brought on the full-effective area of the seat, also to provide a dash pot action for prevention of chattering. A spring guide rests on the poppet and retains a spring, tension of which can be adjusted by means of a steel screw inserted through the top of the valve. This adjustment can be locked securely by the lock nut, which is tightened against the housing on the adjusting screw.

An entirely different type of construction is illustrated in Fig. 5. This relief valve, manufactured by the Adel Precision Products Corp., typifies the ingenuity of this company. Principal feature here is that the poppet is held stationary in an AN standard body, and the seat is lifted off the poppet when the pressure builds up beyond the tension of the adjustable spring.

Developed primarily for hydraulic systems operating at 3,000 or 4,000 psi., full advantage is taken in pressure balancing in the relief valve manufactured by Greer Hydraulics, Inc., (see Fig. 6). This valve is so well balanced that it is equally effective whether it is used at 400 or 4,000 psi. Result is that the valve is very light in weight, and a very lightly loaded spring can be used with a tension of only 20 lb. at 1,500 psi. against 165 lb. normally used. This light spring does away with the wire-drawing effect previously discussed, resulting in a smooth, easy operating unit.

Another very valuable feature of this valve is that the pressure setting is only slightly affected by the back pressure of the return manifold of the system, enabling the valve to be used where sensitive relief pressure setting is required, such as in aircraft gun turret installations and high pressure systems. The valve consists of a body (dimensions conforming to AN standards) which is made from aluminum alloy plate stock. The seat is screwed in from the bottom of the housing and contains a steel poppet inserted in the seat. The seat is effectively sealed by synthetic rubber packings so that the pressure is isolated around the annular groove of the seat through which holes are drilled, permitting the oil to flow about the neck of the poppet. The annular groove plus the flow around the poppet neck provide a large flow area, resulting in a very low pressure drop through the valve under normal through-flow.

It can be seen by careful study of Fig. 6 that the diameter upon which the poppet seats is slightly larger than the diameter of the poppet shank. Difference between these concentric diameters is the effective working area resulting in the light load. A seal in the poppet shank prevents pressure from building up under the valve destroying this differential. The spring seats directly on a shoulder provided in the poppet, and the tension of the spring is adjustable by means of the adjusting screw, inserted from the top of the housing.

Winning With Scrap

(*Continued from page* 187)

and other oils are reclaimed through use of a portable filtering machine. Waste paper from offices is shredded and used in packing.

Even dry cell batteries for flashlights, formerly a total loss after they had gone "flat", now are kept in use over a long period of time—for the material conservation department has put a battery recharging machine into service. This apparatus will restore life even to the small pencil-type dry cells.

Much of the reclamation work is done by the conservation department while some is done by the plant maintenance departments, which also aid the conservation drive by utilizing their own scrap for re-use.

The conservation department also operates a parts-sorting section which both manually and by machines, separates parts which are unavoidably mixed. They are then returned to the production departments.

Production Analysis

(*Continued from page* 183)

25) should be available for detailed shop development. The line assembly planners, in conjunction with their respective assistants, should personally supervise the installation of the job units, incorporating minor changes, and keeping file cards, job unit operation sheets, and production boards up-to-date. Close coordination with production control should be established, in addition to supplying up-to-date job unit operation sheets. As these sheets are completed, duplicate copies should be forwarded to the production illustration, which will prepare all perspective job unit drawings for both final and feeder line assembly.

Black-and-white prints should be shellacked or varnished to $\frac{1}{16}$ or $\frac{1}{8}$ in. plywood boards and placed with the job-unit parts box. Zone job units for one station should be located near the job unit disbursement depot for a specific station. As parts job units are issued by production control, the workman should be assigned the approximate job unit illustration for use in its specific zone. Job unit illustrations also serve as check lists. As sheets are revised, duplicates should be forwarded to production illustration in order that changes may be incorporated as quickly as possible.

Production Control

Responsibility of maintaining a system of parts disbursement for the station job units should be assumed by production control, initially by development of control procedure, then by obtaining from each unit lead planner a copy of stage analysis sheets which establish preliminary priorities. The information received will establish preliminary and temporary parts routing and disbursement depots. Production control should keep in close contact with assembly line layout in order to assure the most efficient parts flow, handling, and storage details.

As the station analysis progresses, production control should be furnished

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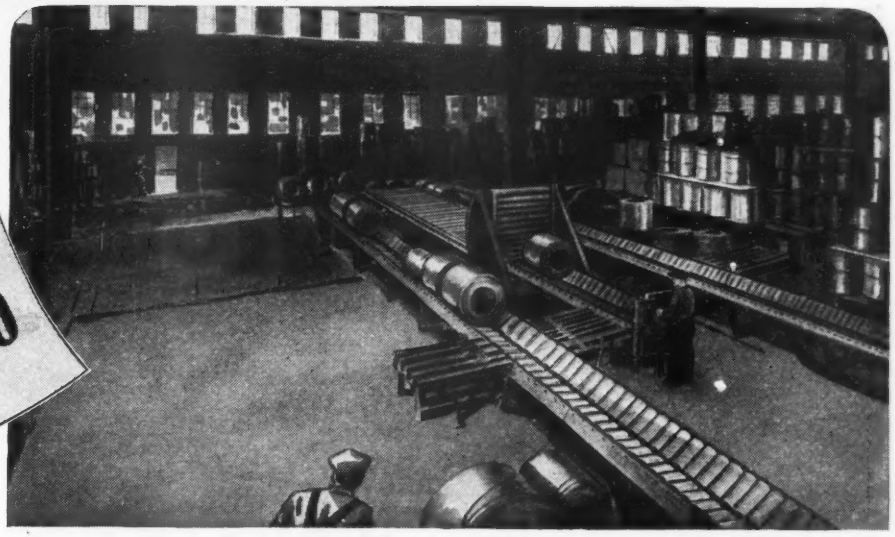

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duplicate copies of established job units—operation sheets which definitely establish the location of parts and assemblies for the final assembly lines.

Parts storage and disbursement may be handled by setting up parts bins or racks at each station, providing in the bin a space for each job unit in each zone numbered relative to zone and station. In each compartment should be placed a pan or box containing those parts and assemblies scheduled to go in that specific zone for its particular station. These boxes should be issued to a workman with the job unit operation sheet and illustration. As compartments are emptied, production control should refill, noting any shortages, etc. Wherever necessary, production control should recommend the establishment of an open station in the assembly line for shortage and salvage pick-ups.

By careful coordination with all departments, production control will assure an even flow of parts and assemblies to their stations, insuring the successful and efficient operation of the assembly line.

Production Illustrations

For the purpose of providing clear, concise production information, illustrations of the perspective type are prepared.

The detail development of production illustrations should be done currently with the three foregoing production phases. One preliminary production breakdown should be prepared in the airplane preliminary design stage based on information furnished by the project engineer and design layout men. It should be a complete airplane unit breakdown, rendered in simple, shaded-block form, showing available design detail developed from a master perspective layout projected from three-view. This should be approved by the project engineer and layout men.

Final production breakdown should be prepared from a revised preliminary breakdown to conform to production design decisions established in preliminary production conferences. It may be presented as a series of six drawings covering these items: Major unit breakdown, minor unit breakdown fuselage, minor unit breakdown wings, structural drawing number references, functional installation drawing number references, and major unit dimensions.

Unit breakdown illustrations should be prepared from production layouts or release drawings, presenting detailed production information by name and part number. Major unit structural drawings illustrate units such as center panels, outer panels, etc., and should designate by name and number all subassemblies and details. Drawings of structural subassemblies illustrate engineering subassemblies, and should designate by name and number all detail parts. Installation major unit drawings illustrate complete functional systems, such as flight controls, radio, electrical, etc., and should give by name and number all minor installations. Installation minor unit drawings illustrate minor installation assemblies, such as air controls—fuselage and hydraulics—center panel, etc., and should term by name and number all subassemblies and detail parts. Drawings of installation subassemblies illustrate functional subassemblies, such as instrument panels, hydraulic unit assemblies, etc., and should likewise designate by name and number all details.

Planning-bench assembly drawings should be prepared from information furnished by the production planning department, conforming to an operation sheet. These drawings should illustrate the assembly procedure required, being coordinated with a related operation sheet by numbers. These drawings should designate all parts by name and number and should be approved by the corresponding lead planner (Fig. 8).

Job unit illustrations should be prepared from zone-station operation sheets from master perspective layouts, the particular view being determined by the relationship of the workman to the airplane. These drawings should be coordinated with the job unit operation sheet by operation number, zone, and station, in addition to naming and numbering all parts.

Jig and fixture sketches should show the subject jig or fixture, a phantom outline of the jigged assembly, and list the complete sequence of assembly (Fig. 9).

Skeleton perspectives should be prepared by projection from three-view form, with the view being determined by the type of airplane illustrated. The skeleton perspectives usually required are: A complete airplane, a detailed fuselage, and detailed wing drawings. These drawings should name all necessary station lines, outer lines, bulkhead locations, spar locations, etc. (Fig. 10).

Application

Normally, in order to facilitate the planning of an aircraft destined for quantity production, the relationship of its components to line assembly would be considered in the original design.

This preliminary consideration may best be accomplished by thorough coordination among the various departments during the preliminary and production design stages. If this is done, the subsequent automatic correlation of production and design requirements will result in a successful production design and no difficulty will be experienced in its application to line assembly.

Lockheed Spotwelding

(*Continued from page* 165)

It is possible to make a high pressure resistant tank of this same general shape by using torch weld, but scallops and other special construction will be necessary. Other methods using bolts or rivets could be used, but to date they have proved considerably heavier and more difficult to manufacture, even when the pressures are not high. On heavy roll-weld equipment, three thicknesses of material may be seamwelded successfully with external brackets spotwelded to the tank halves for mounting in the airplane* as shown in Fig. 13.

On the present production version of the *Constellation*, practically all powerplant structure forward of the firewall is made from heat and corrosion resistant steels—AISI 302 and 347 sheet in varying degrees of hardness. Spotwelding applications on these fireproof installations include the engine mount structure, cowl flaps, cowl structure, and outer panel assemblies.

Drilling of stainless steels has always been difficult, due in part to the work hardening of the sheet at the holes if a sharp drill is not kept under constant cutting pressure. With the relatively unskilled men and women doing this work for the duration, this problem is somewhat aggravated. Riveting of thin gages of these steels, necessarily employing special rivets, is very difficult. In maintaining a flush outer surface, the riveting problem is further aggravated. Spotwelding the power plant installations, though, eliminates these difficulties.

Where the assemblies are light in weight and holding of parts in their relative positions has been accomplished with clamps and simple light weight fixtures, the assemblies have been moved to stationary equipment for the welding operations. With the welding of larger and more complex sections, such as engine mount structure and some cowl panel assemblies, it becomes desirable to use portable equipment. This equipment for welding steel sheet is readily adapted to utilize the same basic type jigs and fixtures (trunion, horizontal fixed, and vertical fixed) used for riveted and bolted assemblies (see Figs. 14, 15 and 16).

To date, no portable spotwelding equipment has been obtained for aluminum alloys, although applications have been made for its use on the *Constellation*. One of these uses is the

* Use of seam, roll spot, and single spot welding has made it possible for Lockheed to produce quantities of low carbon steel droppable fuel tanks. These tanks are successfully used on a great many types of aircraft to almost double their range of operation. Also see Von Hake, R. A., AVIATION, June, 1943, p. 128; Coker, M. A., *Machinery*, May, 1943, p. 161, and Hoffman, F. C., *Iron Age*, May 15, 1943, p. 27.

attachment of outer window and door frames to the fuselage skin, where at present employment of rivets driven flush on both sides is required. When portable equipment for aluminum alloys does become available, additional advantages of spotwelding will fly with the *Constellation*.

NACA . . . The Force

(*Continued from page* 175)

tified its existence, they had made it an indispensible component of the national welfare.

Flying became more and more of an industry. . . Planes had more powerful engines and flew faster. . . . Airlines, like the Post Office whose mail they carried, decreed that neither snow nor gloom of night should stop them in their appointed rounds. . . . New methods had to be devised and new flying technique. . . . And pilots had to know not only *how* their planes flew but *why*. Yes, someone had to find out about these things without killing a lot of good men in the process.

Accordingly, the NACA provided the information, and while European airliners sat on the ground during the hours of darkness, all the airlines in America drafted and flew their schedules regardless of the hour of day or night. It was not to the men in the air that most of the credit was due—though they were of the world's finest—but to the men on the ground, the experimenters, the foreseers of the hitherto unforeseen, who made possible the tremendous achievements of American aviation.

Coming down to the present day, there has been a marked increase in the size of the great sphere covered by the Committee. Obviously, this has required many more workers and much equipment. Congressmen and Senators, now more airminded than many give them credit for, have provided the money—and the work has progressed steadily.

The war has thrown an immense amount of Army and Navy experimental work on the Committee's hands, and for the first time the Committee admits it is under an overload. In spite of enthusiasm, regardless of uncounted hours of night work, the present force finds itself not only handicapped but falling more and more behind in its task. It is essential that we retain air superiority over the Germans in spite of their technical ingenuity, but this cannot be done unless we find out before going into battle that what we make and what we send into the fight are better in every respect than those which oppose us.

What are the steps proposed or already taken to assure this air superiority? In what ways can scientific research keep us ahead of other countries? Let us consider the four NACA experimental laboratories in the light of being a national life insurance and, after that, let us consider the premium to be paid.

Langley Field, Va., now has 20 wind tunnels in operation. There is required a new Laboratory of Study of Induction Aerodynamics, covering the subjects of combustion and air cooling. Already this section has made improvements in ducts and passages within the airplane which increase its efficiency as effectively as would important changes on exterior aerodynamic design.

The Electronic Laboratory tests aircraft instruments to increase their efficiency under extreme flight and atmospheric conditions.

Cleveland Engineering Laboratory engages in gas turbine and compressor research. When future engines give out more horsepower on less weight and with smaller fuel consumption, their success will be directly traceable to the careful, painstaking but unpublicized work of the CEL engineers.

When PBY's take off on regular daily schedules through the tough Alaskan winter and return to base as a matter of course, their safety is in great measure due to the anti-icing research done by Ames Laboratory. As their radios continue to send and receive in the worst sleet and snow storms, bringing them back to base instead of leading them astray, how many of the crews will know that they owe their lives to the work of that small almost unknown group of scientists at Ames Experimental Laboratory—the men who foresaw and guarded against the effects of storm static while the equipment was still in the design stage.

In the future—and not so far away—when fighters fly at supersonic speeds, the credit for research should go to the men who looked into the future and saw the need for experimental data, then designed and built a supersonic wind tunnel at Moffet Field and made the discoveries which will render these planes possible. Possibly one or two pilots may know vaguely that certain scientists had a hand in the early experiments, but the man on the ground—who pays the taxes which make these things possible—will know little or nothing about the NACA.

He will know nothing, unless someone informs him about the huge Moffet Field wind tunnel, with a throat 40 ft. high and 80 ft. wide, which can test a full-size airplane, thus enabling manufacturers to eliminate faults before accidents occur in flight. He will surely be proud of the fact that we won our air battles by a margin of one plane lost to five of the enemy, but he will not know, if he is not told, about the part played by the NACA, nor will he realize that our air superiority in peacetime will be directly the result of its work. The engineers and scientists who achieved these results would know these things if they stopped to think of them but they don't stop—they're too busy.

How much is it worth to this country to make sure we won't find the Luftwaffe our superiors when we start the "Second Front"? We spend in one night over Berlin more than $20,000,000. The NACA requires—now—$17,546,700 for this year's work. These raids are prime factors in winning the War. How can we do more toward Victory than by spending the price of one air raid in research which will keep our Air Forces in the position which the NACA has made possible?

Remember, when we invade Germany we don't want a "Battle of Britain" in reverse.

Plane Sales Target

(*Continued from page* 117)

asked to indicate which five held the most appeal. The features, in order of their ranking by those interviewed, with the percentage selecting each, are shown in the following table:

Rank	*Feature*	*Selected by (%)*
1.	Can be soloed with 4 hr. instruction	45.5
2.	Four-passenger cabin	43.2
3.	Simplified control	38.8
4.	Life expectancy of craft same as an automobile	37.6
5.	All metal—stainless steel	36.0
6.	Good visibility, both taxiing and flying	34.2
7.	Landing speed not to exceed 35 mph. (short landing run—200 ft.)	33.2
8.	Cruising speed of at least 120 mph.	30.4
9.	Folding wings or blades	24.6
10.	Dual controls	23.8
11.	Can be operated safely from 500 ft. landing strip	17.2
12.	Fuel capacity 5 hr. at 7 gal. per hr. max. consumption	16.2
13.	Instruments incl. compass, airspeed, altimeter, oil pressure, and temp. gages	15.8
14.	Two-passenger cabin	12.2
15.	Mechanical starter	11.6
16.	Heater, ventilator	9.4
17.	Tricycle landing gear	9.0
18.	Hydraulic brakes	7.6
19.	Minimum baggage cap. 30 lb.	6.2
20.	Upholstered interior, good appointments	5.2
21.	Entrance on both sides	4.2
22.	Push-button control radio	2.6

Use of this card-questionnaire also served to reveal that the specifications listed thereon would, on the whole, satisfy the majority of prospects, although 27.4 percent wanted something additional and 25 percent voiced an objection to at least one.

Most important of the added specifications desired were mechanical devices—a long list of aids and gadgets which were believed capable of adding mechanical guarantee that the pilot and passengers could not get into trouble. A total of 32.1 percent of those desiring an added feature listed something falling in this category.

Next most-desired added feature was two-way radio, selected by 11.3 percent, followed by these: Parachutes, 8.2 percent; automatic pilot (both for ea

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ing and safety), 6.9; miscellaneous operations aids, 5.7; greater baggage capacity, 3.8; fire extinguishers, 2.4; controllable pitch propellers, 1.9 percent; maintenance by the selling agency, 1.9 percent; radio locator, 1.2 percent; and flight instruction by the seller, 1.2 percent.

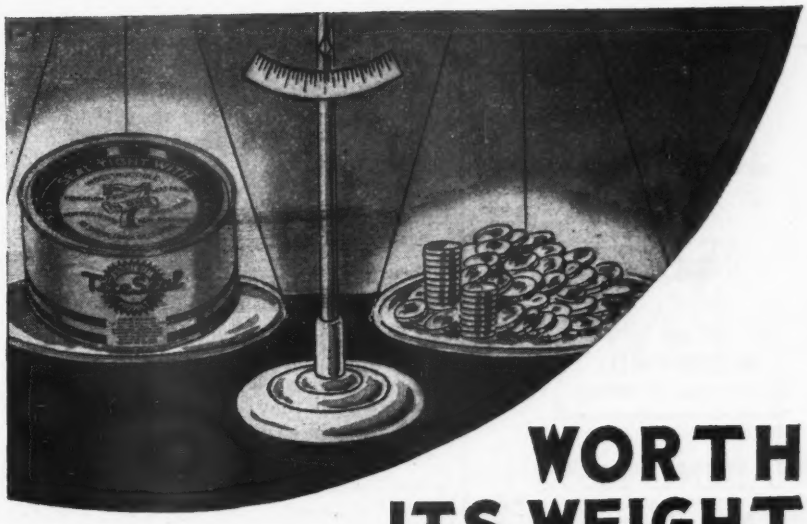
Analysis of the questionnaires led the research organization to believe that many of the 25 percent who voiced objections to one or more of the proposed specifications either misunderstood or simply had no comprehension of the subject. Some 8.5 percent, for example, misunderstood to the extent that they applied aircraft specifications to the helicopter; 1.5 percent objected to entrance on both sides, expressing the fear that they might fall out; and others applied past personal experience with some defective mechanical equipment in aircraft.

The most serious objection was on baggage capacity, for 40.6 percent thought the 30-lb. capacity too small. Another 10.2 percent said the 5-hr. fuel capacity too small. But there is a tendency to discount this somewhat, since many interviewees did not tie it in closely—or at all—with the proposed 120 mph. cruising speed. Dual controls were objected to by 7 percent on the ground that they were distracting, complicated, or dangerous.

Despite the indicated desire for added utility of light craft, 65 percent of those questioned said they would use the fixed-wing plane or helicopter for pleasure, against 35 percent who would use it for business, including commuting. Of those who would use the aircraft for pleasure, the largest number appear to be fishermen, either lake, stream, or deep-sea—for that use was mentioned most frequently among the 33.6 percent who said they would like to fly on vacations. Another 20 percent, while not mentioning vacations specifically, would want to use their aircraft for visits to friends and relatives living in places now inaccessible by surface transportation due to the time element.

Of the 35 percent giving business as the principal reason for wanting to own a skycraft, 28.8 percent expected to use it for commuting, but only 18 percent of that group consider commuting the primary use. Among specific business uses mentioned were: To expand business into new markets; to make special buying trips; to be able to give quick demonstrations of products to prospects; and advertising.

The survey also indicated that business men expected to find greater utilization of aircraft than do professional men, for 41.7 percent of the business men interviewed expected to use it for business, as compared to but 30 percent of the professional men. Regardless of



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the anticipated use, however, business and professional men appear to make equally good prospects, since the variation was but 0.2 percent per hundred. In this connection, the survey revealed that women may be expected to be as good prospects as men, for the variation there was but 0.417 percent per hundred.

That some sort of financing will be necessary if any sizable postwar market is to be developed is indicated by the fact that 47 percent of the would-be buyers said they would take advantage of automobile-type financing if it were available. Popularity of the time-payment idea varied by as much as 17 percent between cities. In Kansas City, for example, only 15 percent of those who said they intended to buy reported that they would use an easy payment plan.

It should be noted that this group included *all* who said they would buy, whether or not their answers to other questions ultimately put them in the definite prospect group. Other cities, measured by the same standards, were as follows: Chicago, 15.5 percent; St. Louis, 17 percent; Dallas and Indianapolis, 18 percent; Columbus, 20 percent; New York, 22 percent; Atlanta, 28 percent; and Pittsburgh, 32 percent.

Fortunately, most people have not yet been convinced that they will get $400 roadable helicopters or fixed-wing planes, for 72.6 percent of those indicating an intent to buy expect to pay at least $1,500 for either type. A smaller group, amounting to 8.1 percent of those interviewed, expect to buy and expect to pay more than $2,250. Here, again, the variations between cities showed a wide range, the percentages running as follows: New York, zero; Columbus and Kansas City, 1 percent; Indianapolis, 2 percent; St. Louis, 3 percent; Dallas, 4 percent; Atlanta, 9 per cent; Chicago, 11 percent; and Pittsburgh, 13 percent.

That the majority of postwar flyers will be owners rather than renters was indicated by answers to the question, "Would you be interested in flying a rented airplane or helicopter on some basis like that used by the Hertz Drive-It-Yourself arrangement?" Those answering "No" totaled 63.5 percent; those saying "Yes" totaled 22 percent, and 14.5 percent said they were undecided. On this point it should be remembered that the vast majority of those interviewed were 40 and over and were in the higher income brackets. Inclusion of a larger number of younger people, or inclusion of lower income groups, would undoubtedly alter these figures materially.

Based on the assumption that all aircraft manufacturing plants will be fully occupied with military plane production right up to the end of the war, 40 percent of those questioned were of the belief that the proposed "family car of the air" would be available within one year of the signing of the Armistice: 23 percent thought it would take two years to develop; 20 percent considered themselves unable to make an estimate; and 17 percent thought it would be on the market within six months.

Of those who indicated they intend to buy either a fixed-wing job or helicopter, 24.6 percent said they expected to make the purchase as soon as the craft becomes available; 15 percent within six months after the time it comes on the market; and 17.6 percent within a year of its availability. Of those who do not intend to buy within the first six months, 61.6 percent were listed in the following categories: The "let George do it" school; those who wanted to wait for public acceptance; those who thought major improvements would be forthcoming soon after initial deliveries; and the class of people who are inherently prone to let others do the experimental buying that always accompanies a new product.

Another 15.3 percent of those who expect to delay their purchases by six months or more said they wanted to "recuperate (financially and otherwise) after the war" before making any such investment.

A final question designed to determine the extent of the interviewees' aeronautical background brought out the fact that 58.5 percent had made at least one flight, and of this group an even 57 percent was recorded as intending to buy a fixed-wing aircraft or a helicopter. Of the 41.5 percent who had not flown, 23.7 percent were classed as definite aircraft prospects.

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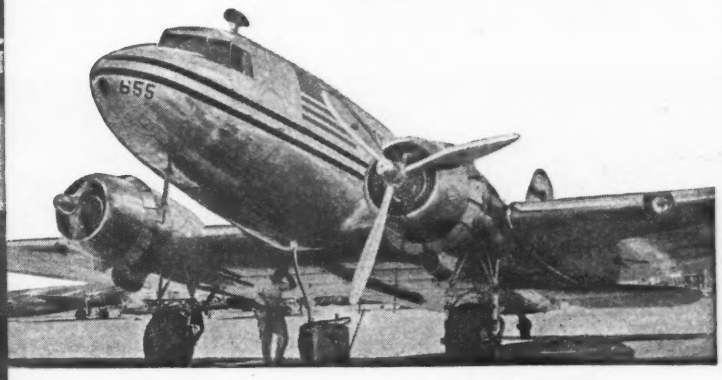

To help maintain its crowded war-time schedule, Pan American World Airways depends increasingly upon the Rectostarter. They've learned, through actual use, the dependability of this Mallory portable DC power supply in starting aircraft engines and as a source of power for plane lights, radio and instruments while on the ground.

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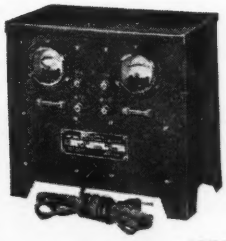
For applications that do not require portability, the Rectostarter is also available in stationary units with one or more DC outlets. See your Mallory distributor, or write direct.



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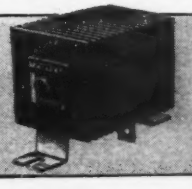

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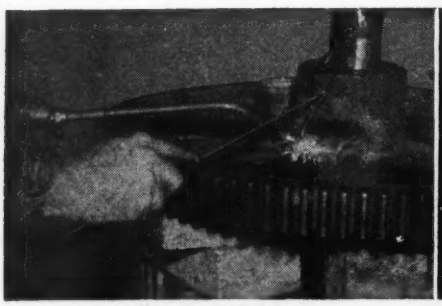
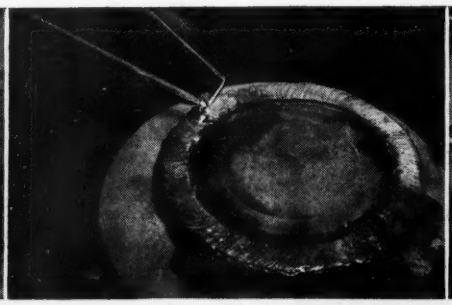
Oxy-acetylene processes are used throughout industry to speed up production, to conserve materials, to lower operating costs, and to simplify problems of maintenance and repair. Some of the many oxy-acetylene applications are outlined here.



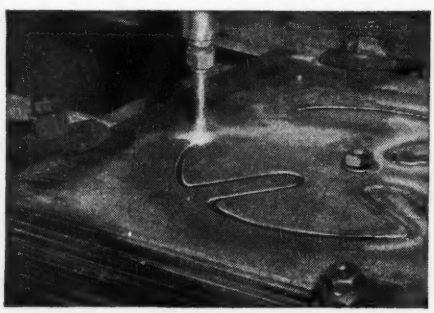


Bronze-Welding **Resurfacing** **Hard-Facing**

The oxy-acetylene flame makes possible the joining of practically any metals—like or unlike—so that the weld is as strong as the base metal itself. *Bronze-welding* speeds the repair of cracked or broken steel and iron parts right on the job. *Resurfacing* of worn parts with steel, iron, bronze, or other types of welding rod avoids delays and conserves materials. *Hard-facing* with Stellite alloys makes parts that are subject to abrasion, heat, or corrosion last from two to twenty-five times longer. Welded piping systems use less fittings, occupy less space, and remain leakproof and maintenance-free indefinitely.

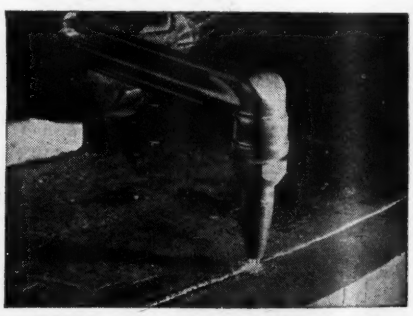
Machine Shape-Cutting

Shape-cutting quickly produces simple or intricate steel shapes with clean-cut edges that usually require no machining. This method is also used for bar and billet cut-off, for straight-line cutting, and for preparation of plate edges prior to welding.



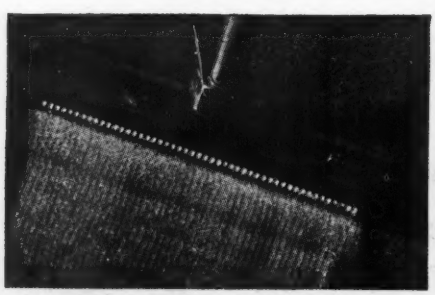
Stack-Cutting

Stack-cutting of tightly clamped piles of plate is an adaptation of shape-cutting to permit fast production of quantities of identical parts. This oxy-acetylene method usually is faster and more economical than shearing or other mechanical methods.



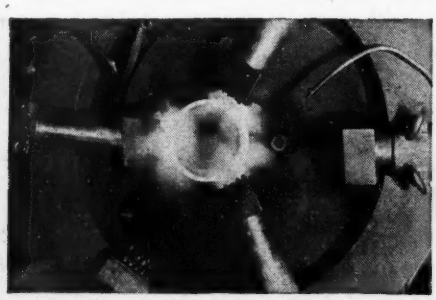
Hand-Cutting

Hand-cutting speeds the cutting of structural steel to length, quickly severs gates and risers to reduce machining, and facilitates alteration work. With Oxweld gouging nozzles, a groove of surface metal can be removed without harm to adjacent areas.



Flame-Priming

This process removes loose scale, rust, and surface moisture from steel prior to painting—making paint go on faster, bond tighter, and last longer.

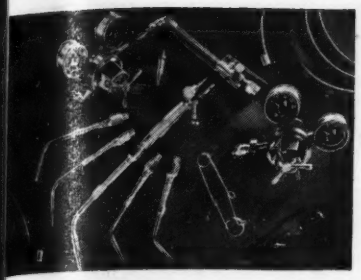


Flame-Hardening

This oxy-acetylene process is used to impart a hard, wear-resistant case to steel and iron parts without affecting the toughness of the core.

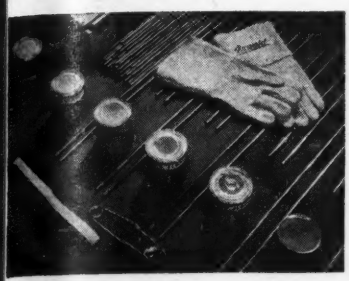
Heating

Heating for bending, straightening, and forming operations is facilitated by the oxy-acetylene flame. Shown here, a pipe is being wrinkle-bent.



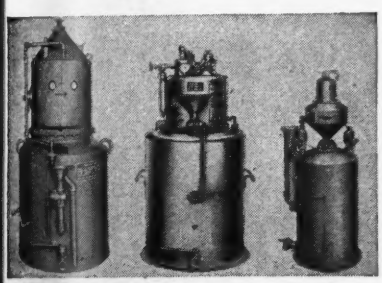
Hand Apparatus

Oxy-acetylene apparatus which may be ordered from Linde includes oxy-acetylene blowpipes for all welding and heating work; oxy-acetylene cutting blowpipes, cutting attachments, and nozzles; and oxy-acetylene descaling and flame-priming equipment. Oxweld apparatus is supplied from Linde offices and warehouses. The Purox and Prest-O-Weld lines are distributed by industrial and automotive jobbers. Prest-O-Lite air-acetylene appliances for soldering and brazing are also distributed by these jobbers.



Welding Rods, Fluxes, and Supplies

Oxweld welding rods and fluxes are of exceptionally high quality. The many kinds and sizes of Oxweld rods make it possible to select the one that will give best results on each job. The Oxweld line also includes gloves, goggles, lighters, hose, ferrules, and asbestos paper. Rods, fluxes, and supplies may be ordered from Linde or from automotive and industrial jobbers.



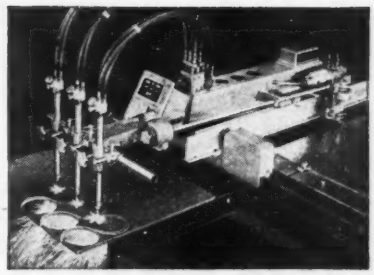
Generators and Manifolds

Oxweld acetylene generators produce low-cost acetylene and are made for both portable and stationary use—with maximum generating capacities of from 30 to 9,000 cu. ft. per hour. Oxweld oxygen and acetylene manifolds are used for centralizing the oxygen and acetylene supply from cylinders.

Send for This Catalog—

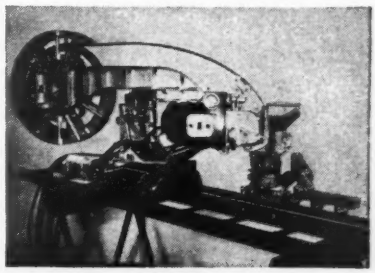
For a more detailed description of Linde processes, and for more information about availability of Linde products, process literature, and process service, send for the descriptive, 8-page catalog shown here.

Machine Apparatus



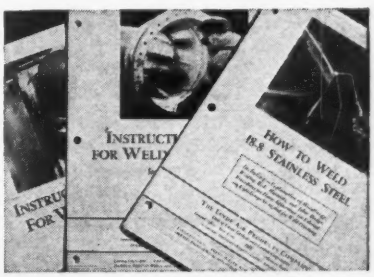
Included in the complete line of Oxweld apparatus are portable and stationary oxy-acetylene shape-cutting machines; straight-line cutting machines; flame-hardening apparatus; bar and billet cut-off machines; equipment for automatic welding; and tractor units for plate-edge preparation.

Unionmelt Welding



This unique electric process makes high-quality welds in any commercially used thickness of steel — in one pass—and without flash, glare, or sparks —at speeds as much as twenty times greater than similarly applicable methods. The process is fully automatic. Speed and current values are established by electric controls adjusted by an operator.

Process Literature



Linde makes available to customers an extensive library of process literature which contributes to the knowledge of operators and shows how to use the oxy-acetylene process profitably.

Oxygen, Acetylene, Carbide

Linde oxygen, Prest-O-Lite acetylene, and Union Carbide are distributed through numerous Linde plants and warehouses located to assure dependable deliveries and low transportation costs. This reflects Linde's efforts to help assure availability of these materials.

The words "Stellite," "Linde," "Prest-O-Lite," "Union," "Oxweld," "Purox," "Prest-O-Weld," and "Unionmelt" are trade-marks.

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Unit of Union Carbide and Carbon Corporation
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In Canada: Dominion Oxygen Company, Limited, Toronto

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First of a series of articles on the preparation of metal surfaces for protective finishes

ALROK TREATMENTS

OF ALUMINUM AND ALUMINUM ALLOYS IMPROVED BY ACP DEOXIDINE PROCESS

It has recently been established that the appearance as well as the effectiveness of Alrok coatings can be greatly improved by the use of DEOXIDINE, a phosphoric acid type cleaner, instead of the alkali solutions formerly used to prepare the aluminum and aluminum alloy parts for the treatment. DEOXIDINE #170 for immersion processes and DEOXIDINE #10E for spray operations are used in water solutions in accordance with regular metal cleaning practice.

Aluminum oxidizes rapidly; but, unlike steel, the resultant oxide forms a protective coating that retards further corrosion. In the Alrok process, a uniform oxide coating is developed, chemically, which both protects the metal and changes and improves its appearance. The object and benefit of the Alrok process is to obtain a uniformity of the oxide coating. In order to secure this, it is absolutely necessary to have a precleaning system that will present uniform, chemically clean, and receptive surfaces to the oxide-forming baths.

Alkali cleaners which, generally, for this purpose are inhibited with sodium silicate, produce a surface that retains traces of silicate and this results in irregularities in the surface appearance of the Alrok coating. In certain instances, the formation of the Alrok coating is completely prevented.

In some plants the alkali cleaning operation is followed by a water rinse after which the parts prior to Alroking are etched in a heated chromic-sulphuric acid bath for from 3 to 5 minutes and again rinsed in water. The resultant Alrok coating contains sulphate ions (SO_4^-), traces of which remain on the surface as a result of the chromic-sulphuric acid pickle. While a uniform Alrok coating is thus obtained, these traces of sulphate ion are detrimental, since they accelerate corrosion and hence will adversely affect the life of any subsequent paint finish.

The Deoxidine process in preparation for Alroking combines the cleaning and etching operations in one solution, thus greatly reducing the time required and increasing the production capacity of the finishing department. The cleaning and the more uniform etching is more effectively accomplished without objectionable or corrosive fumes and, after a water rinse, the parts take a more uniform and durable Alrok coating. The trace residues of the Deoxidine process (phosphates, if left) are anti-corrosive agents that improve rather than impair the life of paint finishes subsequently applied.

The success of Deoxidine for cleaning aluminum and aluminum alloys is but one example of the successful use of Deoxidine for cleaning metals (except zinc and cadmium) in properly preparing them for paint. The thorough cleaning is chemical as well as mechanical and residues, if left, are beneficial to paint life rather than harmful. There are various grades of Deoxidine adapted to the various methods of application and different conditions of the surface.

Chemically Clean Surfaces for Lasting Metal Finishes

Deoxidine method is adapted to cleaning all aluminum, aluminum alloys, steel or other metals (except zinc or cadmium).

Today it is more essential than ever before that aluminum and other metal parts used in construction of aircraft, automotive vehicles and other fighting equipment should be *chemically clean* before the protective finish is applied—else damage from oxides and rust may cause irreparable damage.

There are various grades of Deoxidine suited to the several methods of application and to cleaning where varying amounts of oxides, rust, scale and oil are present.

Our technicians are available to adapt Deoxidine or other ACP Products to your individual production problems. Time will be saved if you will give us as complete details as possible concerning your methods and requirements.

Manufacturers of Inhibitors & Metal Working Chemicals

AMERICAN CHEMICAL PAINT CO.
AMBLER ACP PENNA.

Note—West Coast Plants may address inquiries and orders for prompt delivery to Leon Finch, Ltd., 728 East 59th St., Los Angeles, California.

AMERICAN CHEMICAL PAINT COMPANY, AMBLER, PA.

Please send me general Technical Service Data Sheets on ☐ *Deoxidine #170*

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